The FOUNDRY

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Castings Fit Exacting Needs in Exposed Clocks

NOT so long ago, as history is measured, watches were the property only of rulers or nobility. Even the household clock was a rarity long after men recognized the necessity of time keeping as a measure of the daily business routine. To supply the need for a common standard of time the village clock tower then came into being.

Clocks Combine Art and Precision

By the time that watches and clocks were common, the public clock had become a recognized institution. Today, in thousands of cities merchants, banking houses and government institutions maintain exposed clocks which add to the dignity of the structures they grace. These clocks maintain their vigilance of hours through storms and fair weather, and at the same time must present an appearance of grace and beauty. It is but natural that in filling these exacting requirements the want should be met by the molders art. Nearly every branch of the foundry industry is called upon to contribute. The cases and art work often are cast in bronze. Malleable iron and steel castings may be used for graceful supporting brackets. Pedestals and bases come from the gray iron foundry. The die-caster finds a call for his products in parts of the time keeping mechanism. Aluminum castings supply intricate design with light weight.

Find Where Castings Can Be Sold

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Layout Aids Nonferrous

Red Metals and Aluminum Cast in Separate Foundry Bays—Divide Work to Lessen Fatigue of Workers

FULL co-operation between the foundry and the sales department characterizes the American Mfg. Co., Dayton, which operates a jobbing and contract plant producing nonferrous castings. Castings produced range in weight from 1 ounce to 1000 pounds and include the well known No. 12 and other aluminum alloys, the 85-5-5-5, 88-10-2, and 80-10-10 bronzes, manganese bronze, yellow brass, and acid resisting bronze. Before the sales department offers to bid on any casting or lot of castings, blue prints or sample castings are submitted to the foundry superintendent for estimates on the molding time. If only a blue print is submitted, he determines the pattern and core equipment necessary. If pattern and core equipment are available, the foundry superintendent checks them, and suggests any changes or new equipment if desirable to meet the molding practice of the foundry. These data are used by the sales department in making the bid and no jobs are accepted unless a reasonable profit is made in producing the order.

The foundry has a capacity of 1,000,000 pounds of castings a year. The plant also includes a machine shop and plating department which enables the firm to supply the customer with a finished part if he so desires. The plating department is equipped to provide cadmium, chromium, nickel, zinc, brass, silver and copper finishes.

The foundry which is housed in a separate building, is divided into two bays. All brass and bronze castings are made in one bay and the aluminum alloy castings in the other. This prevents contamination of the brass and bronze with aluminum, which is extremely important in making castings to withstand pressures.

The upper end of the bay in which the brass and bronze castings are made, contains the sandblasting, grinding, metal storage and shipping departments. The melting department lies between those departments and the molding floors. The lower end of the alu-

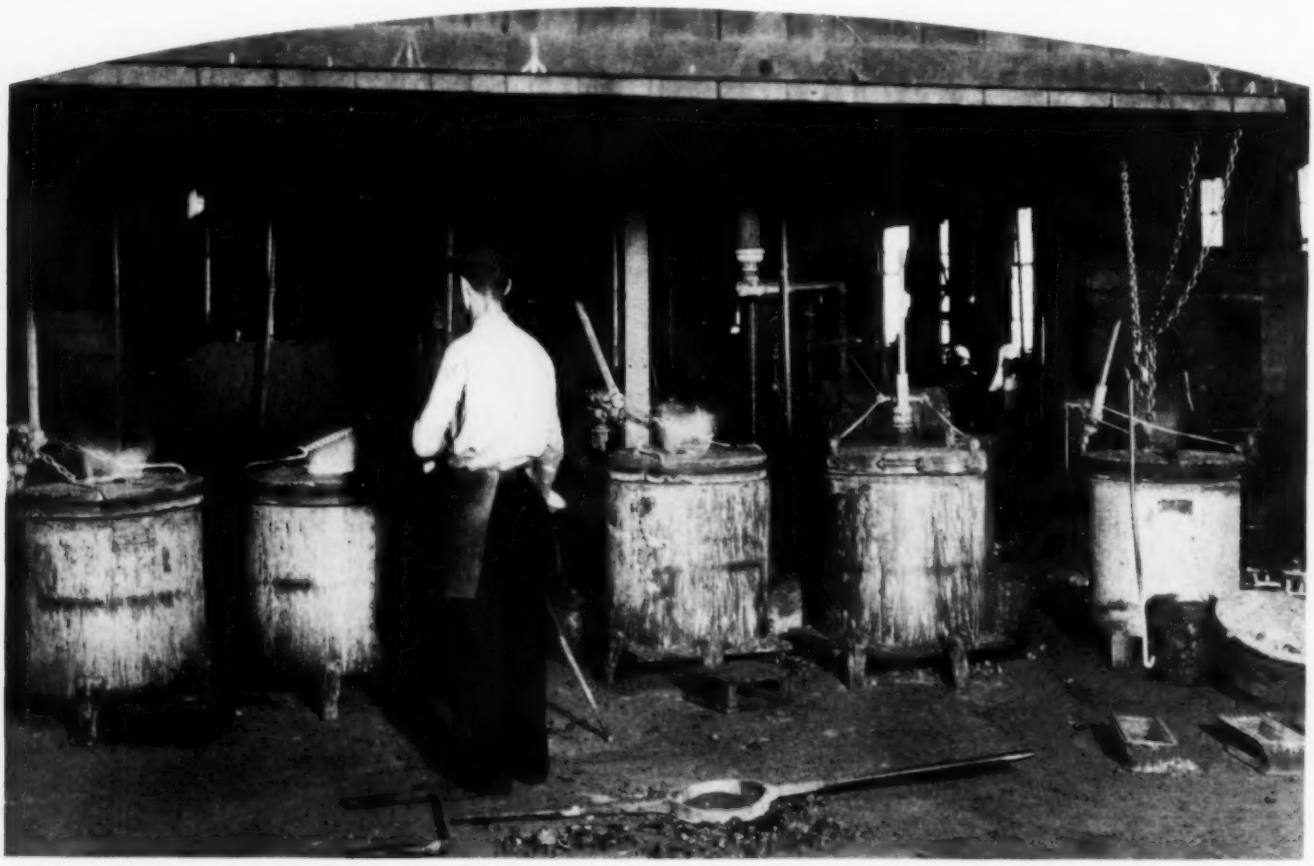

Fig. 1—Brass and Bronze Are Melted in Crucible-type, Gas-fired Furnaces, Aluminum Alloys in Ironpot Furnaces

Production

By Edwin Bremer

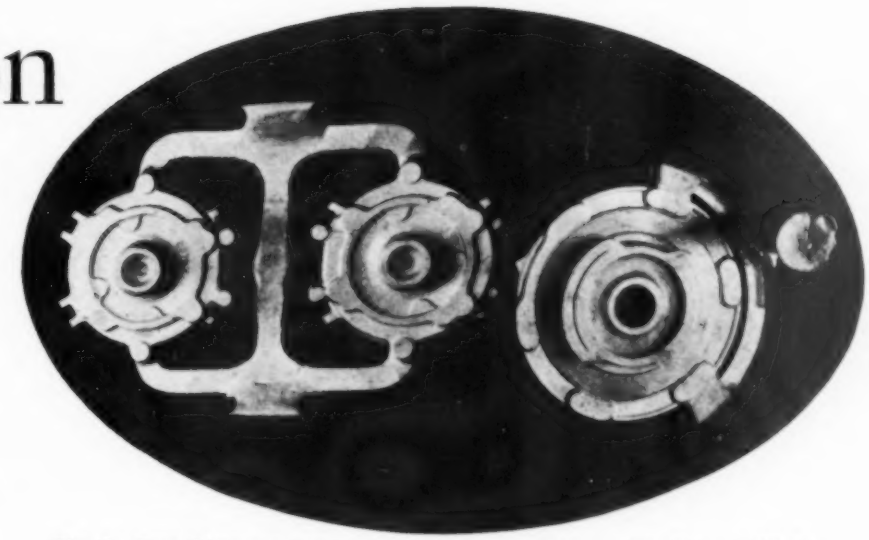

Fig. 3—Two Different Types of Aluminum Castings with Gates Still On

minum casting bay contains the core department which supplies cores for both foundries. Metal for both foundries is melted in seven gas-fired furnaces. Five of the furnaces as shown in Fig. 1 are the crucible type manufactured by the Buckeye Products Co., Cincinnati, O. Each furnace holds a No. 60 pot which has a capacity of about 180 pounds of brass. The other two furnaces used for melting aluminum employ alloy cast iron pots which have a capacity of 200 pounds each. The crucibles are lifted from the furnaces with a chain block and lowered to the floor where they are placed in a double shank carrier. Metal for the aluminum castings is dipped from the pots in small iron ladles which are carried to the molds.

While the furnaces are fired with gas, the firm maintains a reserve fuel supply of 1000 gallons of fuel oil which is stored in a tank in the yard. If the gas supply fails or a break down occurs in the pipe line, the valves to the oil tank line can be opened at a moments notice and melting carried on practically without interruption. No foreign scrap is used in the metal mixtures. The firm purchases ingot metal on an analysis basis which is checked to see that it meets the specifications. All metal poured is tested with a pyrometer to see that it is at the correct temperature.

Usually when copper alloys containing zinc

Fig. 2—View of the Core Room Showing the Pneumatic Core Blower, Core Drying Rack and the Pyrometer Equipped Oven

are melted, a certain quantity of zinc fumes are emitted as zinc is volatilized at 1684 degrees Fahr., which is below the melting and pouring temperature of the alloys. Various means are employed in foundries to carry away the objectionable fumes. Sometimes it is accomplished by placing the melting department in a separate room which is ventilated so that the air currents carry the fumes upward through openings in the roof. Fume hoods placed over the furnaces and attached to stacks or chimneys, with natural or forced draft circulation, also are used. However, the American Mfg. Co. has found that by constructing a wooden curtain or semi-partition which extends from the roof to within about 10 feet from the floor, the fumes are prevented from entering the foundry proper. The partition is placed about 10 feet in front of the furnaces. A full length partition about 10 feet behind the furnaces separates the melting department from the sandblast and grinding departments. A cupola opening in the roof carries away the fumes.

Fig. 2 shows a view of the core room including a pneumatic core blowing machine at the left which was supplied by the Tabor Mfg. Co., Philadelphia, a rack type core carriage, and a gas-fired oven at the right. The oven was supplied by the Swartwout Co. whose oven department now is part of the Foundry Equipment Co., Cleveland. Oil sand blended in a mixing machine with a proprietary core oil is used for cores in brass and bronze castings. Cores for the aluminum castings are made from sharp sand and a proprietary dry binder. Baking temperatures in the oven are checked with a permanently installed pyrometer. The rack for carrying the cores has adjustable shelves formed by lengths of steel pipe suitably supported. The shelves are about 5 inches apart, but since the pipes are not fixed, they may be removed to give any desired shelf height. This feature is useful where the size of cores varies considerably.

Molds are made either on the bench or on molding machines. The American company uses 10 molding machines of the jolt squeeze type. Nine of the machines were supplied by the Tabor Mfg. Co., Philadelphia, and one by the International Molding Machine Co., Chicago. Seven of the machines are located in the bay devoted to the production of brass and bronze castings, and three are installed in the bay producing aluminum castings which is shown in Fig. 4. The foundry floors in both bays are arranged as shown in the illustration. The molding bench or molding machine is placed by the windows so that ample light is provided. The molds are laid down on the floor and extend toward the central gangway.

Kentucky molding sand is employed for the molds and practically all the castings turned out are made in snap flasks supplied by the Diamond Clamp & Flask Co., Richmond, Ind. As is the usual practice in nonferrous foundries, after a few molds are laid down they are poured and the castings shaken out as soon as they have solidified. The sand is tempered and returned to the heap at the molders bench. Before the sand is returned it is riddled through a gyratory type screen supplied by the Great Western Mfg. Co., Leavenworth, Kans. The screen is suspended from a trolley which travels on a track. This arrangement allows the screen to be moved from floor to floor as desired. Each of the three rows of floors has its own screen.

Each molder makes his own molds and pours them. Shaking out, the carrying of the cores, and the mixing and tempering of the sand are performed by other men. This division of work has been found to work out satisfactorily as it promoted efficiency and lessens fatigue of the workers. The additional men required to do the shaking out, sand mixing, etc., are engaged on the basis of one helper to every three molders. Extensive trial of the system has shown that the additional men moving from floor to floor can follow the molders' progress easily, and supply the necessary materials, etc.

One of the interesting features of any foundry is a description of some of the methods followed in its molding practice. To that end a few typical castings depicted in Figs. 3, 5 and 6 have been selected to show the various details. Fig. 3 shows two different types of castings still attached to the gates and risers. The castings shown at the left are made two in a flask, and the casting at the right is made singly. The drag side of the castings is shown at the left. The illustration at the right shows the cope side of another casting.

The pattern for the castings on the left is made of brass with the same material for the set gates or runners. The pattern is mounted in a hard sand match to obtain the proper parting line. This is necessary because the central connecting branch, into which the sprue leads, is curved or bowed so that the enlarged point at the sprue is approximately at the same height as the central portion of the casting. In the drag this point is at the same depth as the lowest point of the casting, and has the tendency to admit the metal to the casting without frothing or turbulence as the metal has to rise in the runner before it enters the casting.

The castings themselves are in the drag and the hollow portion of the shell is formed by a ram-up core six inches in diameter which is placed in the drag. The metal thickness ranges from ¼ to ⅜-inch. The cast-

Fig. 4—The Bay for Molding and Pouring Aluminum Castings Is Separated from That for the Brass and Bronze Castings

tings are gated at two points as may be seen in Fig. 3, and the gates are attached to the casting at the parting line. Approximately 18 machining operations are performed on the castings and many of these are on the various bosses shown in the illustration. Hence, it is necessary to insure clean surfaces at those points which were obtained by placing them in the drag portion of the mold.

The casting shown at the right in Fig. 3 is made one in a flask. The central portion of the casting is flanged and to avoid the use of a three part flask, a dry sand core is used in the cope mold. The casting is gated at two points on the periphery about 120 degrees apart. The branch connecting the two points with the sprue is curved to follow the outline of the casting and is placed approximately ½-inch from it.

Fig. 6 shows two gates of bronze bushings of different sizes. The group at the left are smaller than those at the right. They are made 18 in the flask as compared to 14 for the larger bushings at the right. Since the castings are symmetrical only, one pattern is needed to make both cope and drag halves of the mold. The bushings are cored and the ends of the cores rest in prints which are the same diameter as the cores. Branch gates from the main runner to each casting are the same thickness as the casting and are on either side of the core print. This permits an equal and rapid flow of metal into the casting. Due to the use of a single pattern, the runners and gates are half in the cope and half in the drag.

Two other jobs made in the foundry of the American Mfg. Co. that call for a high degree of skill and workmanship are shown in Fig. 5. These castings are the cases of fare register boxes. The metal thickness of each is approximately 5/32-inch. The casting at the left is 4½ x 12 x 16 inches while the one on the right is approximately twice as large. The interiors of both castings are formed by dry sand cores. As may be observed from the illustration, the surfaces facing out were cast down in the drag.

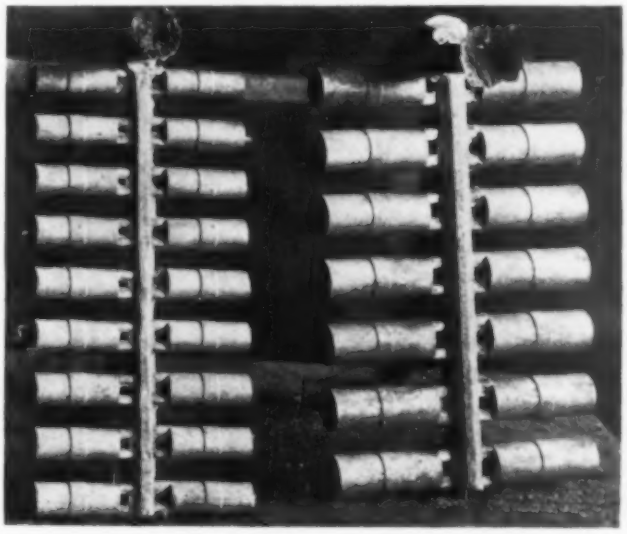

Fig. 6—Gates of Different Sized, Cored Bronze Bearings

The casting at the left was cast entirely in the drag with the cope forming a cover. The core rested in two prints, one at the end and the other in a depression in the drag. The casting was poured through two sprues which fed runners cut parallel to the longest sides of the unit. Metal was fed into the mold cavity by 12 short branches leading from the main runners. The runners and branches were large so that the metal was fed to the cavity with the utmost rapidity. The sprues were placed approximately in the center of the runners located as was stated.

The casting shown at the right in Fig. 5 differs somewhat from the one just described. In addition to the openings in the front and end it contains rectangular openings on each side and a back which is cast integral with the casting. The presence of the plate forming the back prevented the casting being made similar to that previously described. Instead of the whole casting being made in the drag, part was made in the drag and part in the cope. The parting line was made even with the back edges of the openings in the sides. The interior of the casting was formed by a dry sand core which contained five prints. The prints rested in two depressions in the bottom face of drag, in one end of both the drag and cope, and in two cavities in opposite sides of the drag. The top portion of the dry sand core extends up into the cavity in the cope. As may be seen in the illustration, the casting was gated along one end, and at the parting line by a runner extending parallel to that end. The sprue is at the center of the runner which contains six branch gates leading to the mold cavity. Two good-sized risers were placed on the two corners opposite the side containing the gates to insure ample feeding of the casting during pouring.

Cores for aluminum castings are made from a special sand and a proprietary dry binder. They are baked in an oven equipped with a pyrometer to insure proper baking temperatures. Cores for brass and bronze castings are made with sand and a commercial core oil. Since the sand comprising the cores for the aluminum castings is affected little by the molten metal, it is recovered and used again. The method of recovery is as follows: The castings containing the cores are stripped from the molds and given a few raps to remove the molding

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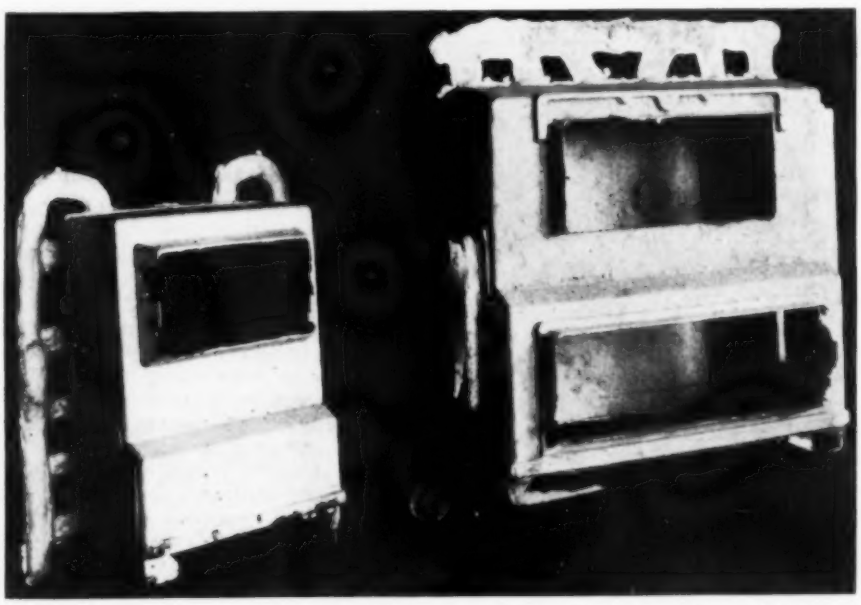


Fig. 5—Care Must Be Taken in Molding and Pouring Thin Castings with Large Surface Areas

Complexities *Confront the* Steel Foundry Industry

By Frederick A. Melmoth

DOES an industry obtain and maintain its position in the business world in a direct ratio to the demand made upon the mentality of its administrators and operatives? If so, surely steel founding should rank amongst the highest.

Manufacturing processes of this commodity are saturated with complexities, some of which are still imperfectly understood. Executive control makes a demand upon a wide range of knowledge, owing to the many and varied operations and materials going to make the complete article. For similar reasons costing systems, telling the real truth about any one job, require more than normal ingenuity to devise, if they are to obviate that curse of the foundry, and other businesses—the average.

Then again, the selling of a steel casting calls for an approach of a type almost peculiar to this class of work, and a knowledge of salesmanship of a general order does not by any means predicate a successful performance in disposing of an output of steel castings at a reasonable figure.

Aspects are Varied

One might reasonably describe our complexities as falling into three main groups:

1—Metallurgical
2—Mechanical
3—Administrative

Normally metallurgical problems would resolve themselves into a straight procedure of providing the necessary materials, melting them in a suitable furnace, and pouring them into a receptacle. This sounds so straightforward that one might easily be misled in considering its effective performance as representing no great difficulties. Unfortunately such satisfactory performance demands scientific control of a whole host of variables. These variables include all those normal to the manufacture of steel ingots, plus a probably much greater number essentially associated with the demands made by sand cast shapes of an infinite variety both as to size and contour.

The ingot maker has an elasticity factor in mold design, a symmetrically shaped and metallic mold able to receive, without erosion or the production of vapor and gases, the steel so carefully produced in the furnace.

The steel founder knows no such heaven-sent state of affairs. In the vast majority of cases, with his steel in the ladle he is confronted by a number of molds made from materials of an erodable, gas-forming type, and of a number of shapes, sizes and thicknesses of section, almost to be described as legion. The variations in one individual casting are sometimes so great as to make the production of it, free from material defects, nothing more than a gamble, with all the odds in favor of the designer. Even the normal average casting, hailed with joy by most founders, is a mass of complexities.

The sand must bear the weight and erosive action of the flow of steel, the gate must be so designed as to pass cleanly the steel into the mold without damage, the mold must be so constructed and of such material as to permit great volumes of almost instantaneously produced steam and gases to pass away freely from the mold cavity and not produce pressure in the sand of the mold, feeding heads must be attached of such shape and size as to supply at the right time the right quantity of fluid metal to make up the void or voids caused by liquid contraction, and yet of such design that they can be economically removed, and finally, while being so strong as to hold the steel, the mold must at the right time be so weak that it offers the minimum resistance to contracting stresses.

Approaching the Problem

These points are sufficient to fully demonstrate the added complexities which arise purely from the fact that exigencies of design make it necessary to use a plastic refractory material from which to form the molds.

The question obviously rises, can anything be done along metallurgical lines to enable the steel to more satisfactorily stand up to the demand imposed upon it by mold conditions?

We know, of course, that the careful control of such impurities as sulphur and phosphorus can assist us in reducing the liability to fracture when cooling from liquid temperatures against mold and core resistance. We know that adequate silicon and manganese content help in

Solving the Puzzle

EVERY phase in manufacturing and merchandising steel castings holds many variables which must be understood if the industry is to prosper. Metallurgical problems must be solved, the proper heat treatment must be utilized, mechanical problems must be conquered, the best cost system must be employed to give accurate cost information and the castings must be sold right. Many of these complexities are discussed in an interesting manner in this article, which is abstracted from a paper presented at the annual meeting of the Steel Founders' Society of America, held at White Sulphur Springs, W. Va., June 28, 1930. The author is metallurgist, Detroit Steel Casting Co., Detroit.

combating the tendency to gas absorption, or more correctly, occlusion. However, in spite of this, we also know that all our steels are singularly susceptible to these effects, and that to some extent, the susceptibility is increased by higher temperatures of casting, normally more necessary for castings than ingots.

Therefore, this complexity is real, as all those differences made necessary when making castings as against ingots tend to add to the difficulties of making perfect castings, and so far as I know there are no compensating factors of opposite effect to ease the situation.

Tabulate Requirements

To evolve any real method of attack on these problems we need a clear statement of our requirements and their causes, and such a summarized statement appears to exaggerate the complexity.

1. *Ingots.* To produce sound masses of steel, the design of mold must be symmetrical and of correct taper to solidify along definite lines of progression.

Castings. A casting is normally varied in section, rarely symmetrical in design and almost never a perfect taper from one end to the other.

2. *Ingots.* To make good ingots the molds must be metallic, dry and clean, and resist the erosive action of the metal, and also give off no gases.

Castings. Our sand castings are compulsorily cast into nonmetallic molds easily eroded if great care is not taken, and capable, usually, of evolving large volumes of gas and vapor at molten steel temperatures.

3. *Ingots.* To avoid piping and cracks in ingots the molds are correctly tapered, no resistance to shrinkage in cooling occurs, and adequate heads are attached at the one exactly correct point to give maximum results.

Castings. Steel castings are indeterminate and variable in section and shape, causing resistance to shrinkage in the solidified state, and making it difficult to maintain a correct temperature gradient from one part to another to allow adequate feeding;

Appreciating the significance of these comparisons, is it a matter for wonder that the statement is so often made that the complexities of steel castings production are not fully realized by some designers? Many designs are such as to suggest a childlike faith in the ability of the steel founder to overcome natural laws

In case the foregoing paints a picture of such gloomy shade as to appear discouraging, it is safe to say that almost daily there is an improvement in the factors affecting these aspects of production. Engineers show an increased willingness to permit foundry difficulties to influence their design decisions and to work along lines offering possibilities of easier contraction and feeding arrangements.

From the purely metallurgical viewpoint, safer steel is being made due to an increasing knowledge of real slag significance, and it does not seem by any means fantastic to anticipate marked development.

Looking into the future it is reasonable to hope for material help in producing good castings from discoveries along one or all of the following lines of, at present, hypothetical development.

1. Steel of stronger crystalline cohesion at the extremely high temperatures just after solidification, giving increased resistance to rupture when cast into a hard mold.

2. Some composition variation of a simple and economic nature, reducing the susceptibility of steel to the unbalancing effects of mold gases, etc.

3. The possibility of the lowering of the fusion point of steel by some addition of a type not adversely affecting physical capabilities of the finished article.

Operations generally described as heat treatment carry along a number of complexities. At one time, either a straight annealing, followed by a slow furnace cooling, or sometimes no treatment at all, constituted practically all the ideas on this subject.

Good Condition Necessary

Higher demands in service, great improvements in machining equipment, and a coincident development of better cutting steels have combined to make it essential that castings be shipped in the best possible physical condition.

Heat treatment has become a highly metallurgical operation. All the standard types of plain carbon steel possess potential qualities to be brought out by heat treatment of a carefully designed type to an extent which is not fully appreciated. Many times a step in the direction of alloy content is taken when a special treatment of a straight analysis could give a physical condition well up to the desired standard. In other words, we are probably guilty of using expensive alloys before we fully exhaust the possibilities of our standard material, carbon steel.

These remarks should not be taken as deprecating the advance taking place so rapidly in alloy steel production in casting form. It is inevitable that continuous expansion in this direction should take place. However, I feel, that apart from certain special requirements, such as heat resistance or resistance to corrosive media, for example, the field of the alloy steels should begin at the practical limit of our standard material. There is no virtue from the performance standpoint in the mere use of nomenclature, and I can easily visualize alloy steels imperfectly understood and their latent properties undeveloped by correct treatment, which to say the least can offer no advantages over good carbon steel. Perhaps I may be permitted to give utterance to a warning in this direction. Unless our special steels give ultra-performance and fully justify their increased cost, the development of such steels will be put back seriously in the casting form.

It will be seen readily that here is a group of complexities meriting earnest thought. When should our old friend, carbon steel, be put aside in favor of a special alloy? My answer would be when some special property is imperative, not possessed by the carbon steel, or when it is decided from the usual strength and the ductility standpoint that its inherent capabilities will not give the desired margin of performance, even when developed to the highest standard by correct treatment. This method of approach will not militate against alloys, it will simply define their true uses. It will insure that each and every expense incurred in alloys means something, and special alloy steels giving results only equal to what skill and knowledge could evolve from plain carbon steel are just wastefulness. It will insure that alloy steel progress is sound, built upon correct fundamentals.

Our steel castings, no matter of what kind or class of material, and no matter how perfectly designed and made, exhibit as cast a condition which only possesses potentially those desirable properties we aim to produce and sell. Their crystalline structure is coarse and weak. True toughness and shock resistance are present in only a small degree and briefly, they would be unsatisfactory in performance in the vast majority of service conditions. Leaving aside the important question of removing stresses locked up in their structure, caused by casting strains and contour or section variations, we must remove these loosely-held, coarsely-arranged crystals.

Knowledge is Important

The phenomenon of recalescence, a correct knowledge of which as it affects, or is affected by, each change of composition, is a controlling feature of all heat treatment, represents in its discovery a scientific achievement of the highest order. The success of modern steel production in meeting a continually increasing performance demand hangs upon an understanding of this fact, that steel at certain definite temperatures during heating and cooling, depending upon its composition, undergoes marked physical transformations indicated by the absorption or evolution of heat, depending upon whether it is being heated or cooled. In ranges dicated by the position of these phe-

nomena on the heat scale, varied rates of cooling can produce properties in the ultimate material over a wide range.

This is just another steel casting complexity not immediately obvious, but depending upon such complex scientific physical phenomena as to become a critical operation.

Under the heading, of mechanical problems I would propose to group some of the factors affecting steel casting production which become operative on the metal after it leaves the control of the melting operation.

The art of molding, particularly as applied to steel foundries, it in itself a complex mechanical series of operations, designed in a large degree to defeat the normal and natural behavior of solidifying steel.

In case this may sound an exaggeration, I would ask for a consideration of the following facts:

1. It is natural for any metal weak in structure at the high temperature close to solidification temperature to crack if resistance occurs to the inevitable contraction associated with cooling. Steel fully conforms to this description, but the customary designs are such as to almost certainly create interference to cooling contraction.

The molder has to anticipate this, and take such steps as to reduce such interference to the minimum, or use artificial means of producing strength at the parts most likely to fracture under the strain.

2. It is natural for a mass of metal to undergo liquid shrinkage when cooling, thus producing voids and unsoundness. The amount of this shrinkage is obviously in direct proportion to the bulk, so that varied thicknesses in any one casting, large bosses, and so on, will naturally have localized increments or liquid shrinkage, with the production of a series of voids.

Chills Must be Studied

The molding art is designed to overcome this natural tendency, either by supplying liquid metal late in the solidification stages of the casting by feeders, or by the attempt to reduce the heat localization effect of varied mass, by absorbing a portion of it through the use of metallic chills, either internally, or externally applied.

The intensity of the action of such chills, by the control of their mass and thereby their degree of heat absorption, is a study in itself, and many of our failures in the use of such aids to soundness are due to a lack of appreciation of the chilling intensity desired to produce comparative regularity of cooling speed throughout the casting.

It can be seen easily that too great a chilling effect merely throws the mass out of heat equilibrium on the opposite side to what would be the case were no chills used at all, and cracking is almost certain to result.

3. It is natural for hot liquid steel to produce, and either absorb or entrap, quantities of gases, when in contact with the materials normally used to make sand molds and cores.

The business of the steel founder is to appreciate this, and to take steps in the construction of his molds to keep gas evolutions to the minimum, and to provide easier means of egress for that inevitably produced, through the mold to outside atmosphere.

Perhaps, when occurrences compel our notice of this particular mold function, we do not always realize the complexity involved in insuring the correct condition. A greater and greater interest in sand, more particularly the backing sand, indicates the significance of this point to most steel founders.

Pictures Conditions

My picture of the condition when liquid steel is cast into sand is as follows: The steel lying on the sand face exerts a pressure due to its own weight, which I will call pressure *A*. At the meniscus of the steel rising in the mold a certain amount of gaseous matter is produced, but in good gating conditions most of this travels just before the steel, and is entrapped to little or no extent. Just behind the sand face in the body of the mold, gases and vapor form at a rapid rate, particularly in a green sand mold. The speed of this vapor production is such that some pressure is unavoidable even when the most open of sand is used. This I will call pressure *B*. If pressure *A* is exceeded by pressure *B* during the period the steel is liquid, or even while the envelope forming first is thin, a change of direction of the mold atmosphere takes place and penetration of the steel itself occurs. If pressure *B* either by a progressively open sand condition, or artificial channels or passages in the mold is always lower than pressure *A*, then no such penetration is possible.

Remembering the almost instantaneous vaporization and great volume expansion of the vapor when steel is cast into green sand molds, it impresses me as a complexity of no mean order to see that the balance of the two pressures is thrown in the correct direction. Choice of mold materials, their careful preparation and correct ramming are essential to any successful realization of the most favorable conditions.

An application of the same line of thought is logical to the explanation of that bane of the steel foundry, the sand scab. I am not including in this class the type of scab formed by the erosive action of the steel in its flow into or through the mold. This is a mechanical defect due to several other causes, a few of which can be inefficient ramming, a poor quality of sand of insufficient strength to resist the mechanical rubbing of the steel flow, or again to the lack of suitable surface reinforcement at points of unusual erosive action.

However, many scabs, appear to form by the use of too close a backing sand, particularly if the facing sand also is close and impermeable.

Statements have been made that our tendency is to over-emphasize the question of sand permeability, as certain quite conscientious observers have found it possible to work successfully with much finer grade facing than was at one time thought advisable.

I suggest to such workers that these matters are ones of degree, and balance between backing and facing. I see no reason at all why one should not produce perfectly sound castings using a facing of low permeability provided the following points are observed strictly:

1. Only the thinnest possible coating of the close facing sand should be used.

2. Immediately behind this facing the mold must be extremely open indeed and if possible, progressively more open as one leaves the mold face.

I believe that the efficiency of the sand part of a steel casting mold is not a question of individual qualities of backing and facing, but is dependent upon a condition of correct balance between the two.

Other Difficulties

There are, of course, many other points in steel castings manufacture, of what might be called a mechanical type, which add to the daily complexity of production, but the article would be prolonged out of reason by an attempt to do justice to them.

Perhaps it will suffice to say in concluding this section, that the fundamental weakness and hazard of almost all our operations in this stage of production is the absolute ease by which the human element and the individual idea can wreck the best of plans.

We can usefully subdivide administrative, as apart from any technical phases of production, into costing, selling and choice of executives. For the purposes of this article these three represent a sufficient scope for discussion, although obviously many other factors, probably of less importance to real success, go to make up the full implication of the word administration.

It has always appeared to me that costing in a foundry, particularly where the product is of a varying nature, is an intensely complex operation. The first essential of any system is that it must tell the exact truth. Arbitrary allocations of certain expenses, averaging in the case of many factors, overhead figures for castings of varied size and complexity, surely cannot be held to give cost figures telling the strict truth. The best of systems strikes me as a compromise, and it is difficult to see just

how this can be avoided. Herein surely lies a complexity of major importance to our industry.

Accurate costing should register the exact effect of the incidence of any job on the shop production.

The following list shows some items of expense in the manufacture of steel castings, and many will be recognized which normally form part of costs averaged in value and applied to the production as a whole, either on the principle of weight or as a fixed percentage on operative wages.

(a) Yield of salable castings per ton of metal used.
(b) Consumption of facing sand per ton of castings.
(c) Fuel of drying molds.
(d) Chills and nails.
(e) Core arbors, etc.
(f) Crane service.
(g) Floor space per ton produced.

These are only given as indication of the sort of thing I have in mind, and a study of the details involved will show a host of other items, some of considerable effect, the cost of which often comes as an equally disposed burden on all castings produced, while the actual demand made by the casting varies over a wide range.

Blocks Production

While this is so, can one truthfully say, disregarding these points, that any particular order is too low-priced to accept, or that such and such a price is remunerative, just because it appears high? In many cases the introduction of some apparently high-priced job of great intricacy merely blocks the production of other lower-priced work, requiring less supervision, carrying less hazard, and if basic accuracy of costing could be attained, probably a greater true profit in spite of its low price.

This is mentioned with one object, and that is the creation of interest, which may lead to the development of some method of costing designed to show these actual effects in the form of money values and so improve our costing control.

I understand that a new uniform cost finding system has just been completed by the steel founders' society which is the best cost plan developed for this industry up to the present time, and which has been designed to meet most, if not all the conditions I have called attention to.

This seems an opportune point at which to introduce the question of selling steel castings. The costing and selling sides are closely interwoven, and perhaps it would be accurate to say that one of the main functions of a costing system is to supply data as a guide for future selling operations. The costing of an already completed job, while valuable, cannot usefully affect us in any way other than as a guide in the case of a repeated opportunity.

The greatest crime committed in a foundry in the name of sales is the overhead price, or the applying of one figure per pound or ton to a mixed lot of work, varying widely in type, size and intricacy. It is done, doubtless, in the pious hope that what one loses on the swings can be gained on the roundabouts, but it introduces an increase gambling element into an already hazardous trade. We know that each of these castings possesses its own distinctive technical problems of manufacture, varying in degree, and the acceptance of this method has always struck me as quite illogical.

Discusses Casting Sales

I referred earlier in this paper to the necessity of an approach in the sale of steel castings of a type peculiar to the material. I number among my intimate friends many members of the selling fraternity, associated with steel castings, and I believe it is quite true to say that their job is a difficult one. We are compelled to admit, primarily, that the steel casting of today, an immensely improved product, still suffers severely from its past shortcomings. The association of a steel casting with serious internal and external defects, liability to failure, porosity, hard spots and so on, lingers in the minds of many people who actually control the purchasing of such articles. We have, necessarily, to convince these people of the progress which has been made along the lines of the elimination of these troubles. To do this successfully fixes the necessity for our salesmen having an intimate personal understanding of the factors involved. In fact, he becomes near to being a technician, and unless his knowledge is sound, many of the people he meets can easily tie him up completely.

The future extension of an industry depends largely upon new fields of application, and only a complete knowledge of the potentialities of a well made steel casting can safely venture into such uncharted regions.

Advantage of Training

It would appear, assuming these premises to be correct, that the only training ground for a steel castings salesman is the foundry itself, and I suggest to you gentlemen, that this is becoming more and more the case.

Such a man, given the necessary degree of natural selling ability, not only possesses a trained knowledge which enables him to state the case for his product, helps him to an evaluation of any proposal from the standpoint of its value to his particular plant, but also fully appreciates the necessity for continuous and intimate association with progress taking place, both in the possibilities of the product and the methods utilized.

The need for the closest co-operation between sales and production ends of the business, tempered by the influence of the cost question, is obvious.

From time to time one hears of attempts to regularize a fixed booking charge on small orders for odd castings below a certain value. Up to now I have not heard that this has become general, but there is no doubt in my own mind that all such orders mean a true loss, and that the suggestion was a justifiable one. Some investigation in England on the effect of such orders showed that in many cases the clerical and similar costs of handling the order amounted to a greater sum than any possible profit, and in some extreme cases was more than the total invoiced value of the job.

It will be easily gathered from the foregoing account of a few of the difficulties of steel foundry production, that the question of choice of men represents a problem. We are faced with metallurgical demands, molding and similar knowledge, organization problems of production, an understanding of refractories, and an appreciation of the full effect of all these on cost. It has always seemed to me that a foundry manager or superintendent needs to be almost a walking encyclopedia of knowledge if he is to answer correctly all the questions which occur daily. As it is unlikely that the replies to these questions can be given by any one person, the matter of regulation of authority, and organization becomes vital to success.

Expects Product to Develop

Work by associations, the encouragement offered by employers to their executives to join such associations, and the development of technical foundry publications, have done much to remove the causes of this slow development. I think it would be true to say that the steel foundry has developed a knowledge of its problems and a general technique, during the last 10 years, to an extent many times as great as ever before, and at the same increased rate of progress the next 10 years should show many beneficial and marked advances of knowledge, and unique innovations in technique.

It is all a matter of the viewpoint existing. The introduction of the more scientific element, whose constant effort is directed towards the elucidation of fundamentals, and whose influence logically tends toward the turning of a hazardous art into an exact science, it met broadmindedly, and not thwarted by an unreasonable persistence of the rule-of-thumb notion, will more and more speed up the attainment of our objective.

This objective, which in one sentence crystallizes the whole of the preceding paper, is, the economic and regular controlled production of steel castings, free from unnecessary hazard, and with their latent possibilities of performance made fully available to the user.

American Monorail Co., Cleveland, has added 3000 square feet of floor space to its plant on Athens avenue for manufacturing purposes.

Steel Founders See Pickup *in Last Quarter*

Annual Meeting at White Sulphur Springs, West Virginia, Directs Attention to Problems of Selling Steel Castings

ACCORDING to members of the Steel Founders Society of America which met recently at White Sulphur Springs, W. Va., business seems to have reached the bottom in castings demand and although no immediate improvement is expected, the concensus of opinion holds hope for decided increases in the last quarter. It was suggested by speakers that the slack in foundry business is more a matter of comparison with the period not so far remote and many manufacturers fail to count their blessings in comparing the present state of orders and operations with the 1921 depression.

More than sixty members of the society were present when President John E. McCauley, Birdsboro steel Foundry & Machine Co., Birdsboro, Pa. called the first meeting to order Thursday morning, June 26, with some brief remarks upon the need for co-operation and constructive thinking. Reports of the finance, cost, membership and other standing committees were presented. Arthur Simonson, Falk Corp., Milwaukee, reporting for Harold S. Falk, of that company, chairman of the industrial research committee, announced the publication of standard trade customs which will be sent to all steel foundries.

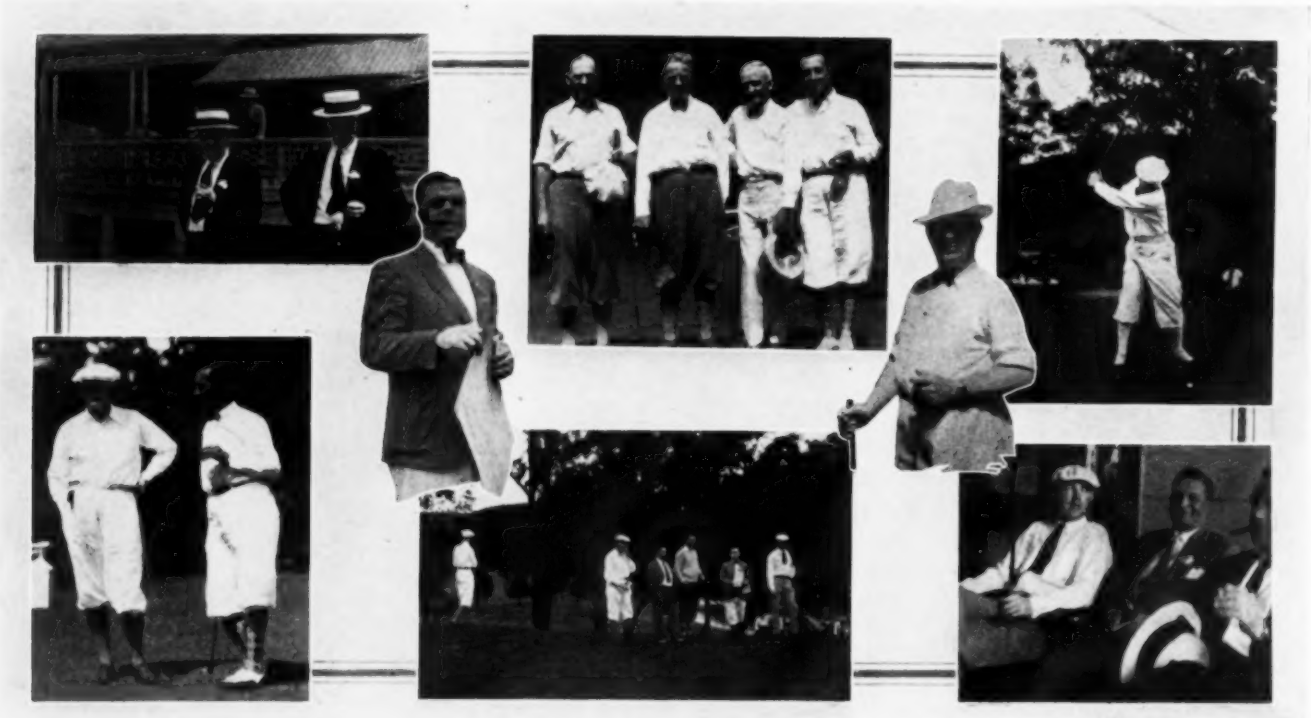
These trade customs which have been modeled after careful study cover the foundry and customer relationships and deal with such matters as quotations, the ownership, responsibility and charges relating to patterns, standard forms for sales contracts, quotations and order acceptance. The trade customs were presented in the June 15 issue of THE FOUNDRY on page 65.

Reports on Merchandising

T. H. Harvey, Ohio Steel Foundry Co., Lima, O., chairman of the merchandising committee announced the work of this committee which looks forward to co-operative advertising of steel castings.

Granville P. Rogers, managing director of the society in his report cited instances of changing trends which have overturned apparently stable markets for commodities. He used these instances to show that such changes signal their advance to the open mind in industry. Those business men who have that attribute are the co-operative type. To avoid industrial depressions manufacturers must know the consumer market in terms of the entire industry as well as in relation to their own plants. Business abuses cannot be corrected by the effort of the individual, but must be dealt with collectively. The value of the trade association in its relationship to the matter of stabilizing markets and improving business conditions was emphasized.

The society has shown marked progress in the past eight months according to Mr. Rogers. With the addition of 22 new members the total companies represented is about 70. Reports of operations, bookings shipments, inquiries supplemented by data on raw material market trends and other information services are fostered by the work of the society.



Following the Morning Sessions During the Three Days of the Convention, the Steel Founders Adjourned to the Adjacent Golf Course for Relaxation

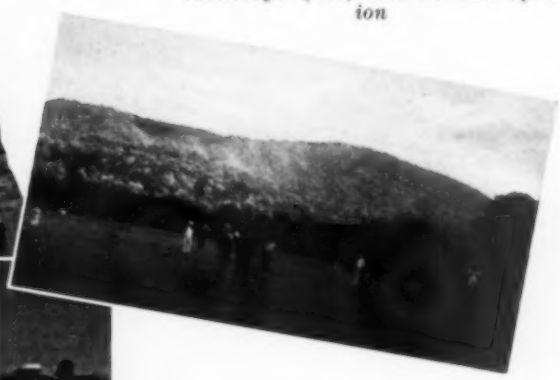
The May report of members was supplemented by verbal reports of members present. A majority report bookings above 60 per cent and operations above 70 per cent. Inquiries are fair, although affected by the normal summer lull in castings sales.

Dr. Hugh P. Baker, manager, trade associate on department, Chamber of Commerce of the United States, Washington, addressed the session on salient points affecting the value of trade association work. He emphasized the need for financing this work adequately, the status of trade association dues as a real business investment upon which a return should be expected. He warned against the reaction which may attend too great devotion to the doctrine of mergers which is sweeping the country, and called the trade association a constructive force for the maintenance of industrial democracy. The trade association was defined as an organization of business men in and serving an industry or trade for mutually helpful service and better business. Trade promotion through the three factors; research or education, advertising, and servicing the commodity manufactured are the proper functions of a good trade association.

The second of these functions, namely advertising in its relation to merchandising was covered by Roger L. Wensley, G. M. Basford Co., New York. He spoke of the contrast between advertised and unadvertised commodities in keeping their progress before the buying world. The comparison between the conception of the automobile purchaser who thinks in terms of the shiny new 1930 model and not the vintage of 1915 and the buyer of castings today who still thinks of steel castings as made 10 or 15 years ago was a case in point. Mr. Wensley voiced the common plaint of the foundry industry that the buyer designs castings to meet his construction needs and does not consider the casting possibilities of his design. This condition might be remedied by proper advertising. Mass education is necessary to turn the buyer away from poor design.

A new era in steel is at hand. The accumulated effect of research is apparent in the swing toward special alloy steel castings. In 1909, according to Mr. Wensley, one ton of alloy steel was produced for every 131.6 tons of total steel production. In 1928 the ton of alloy steel was marked by a 16-ton total. Broadening the field of service of a product through group advertising was recommended. This extension is possible through cultivation of new uses, the education of buyers in the fringe market where two or more products may give similar service and the constant reminder of buyers of fundamental advantages. He recommended individual advertising of trade marked products and the creation of a specialty in which a manufacturer may excel.

Competitors Became Fast Friends Under the Alliance to Best Col. Bogey and His Hazards, Traps and Tricks



Those Not Devoted to the Ancient Scot Sport, Found Time for the Interchange of Information and Opinion

Three exceptional addresses on business topics featured the session held Friday morning. J. Noble Braden, American Arbitration association, New York, commended the society for including in its code of trade customs a provision for arbitration of trade disputes. He traced the history of arbitration procedure and contrasted the merits of such settlement of disputes with the processes of litigation.

Charles F. Abbott, American Institute of Steel Construction, New York, suggested the appointment of a council or commission to consist of representatives of finance, labor, industry and economists to develop the real causes which prevent profitable operation of manufacturing establishments. He quoted previous warnings when business was operating at a higher rate and the question was propounded, "if you can't make a profit in these times, what will you do in a depression?" The present condition in business may serve to impress the lesson that price must be cost plus a profit.

Of the many reasons given for unprofitable operation, Mr. Abbott stated that individual selfishness is first. While the codes of trade practices which have been adopted were commended for their statement of certain moral principles, they have been found impracticable as a panacea for all business ills. Legislation, similarly fails to heal the condition of unprofitable business. Overproduction brought about the present decline and some means should be found to rationalize demand.

According to Mr. Abbott, public welfare demands profitable business, the only assurance of prosperity. Industry can best bring about a proper condition only through co-operative activity. The first question which should be solved is commercial research. Several notable examples of accomplishments by the steel construction group which Mr. Abbott directs were given, including the battle deck type of flooring which in one year has increased the consumption of steel plates by 38,000 tons and eventually will add 4,000,000 tons to the output of this commodity. Costs as a basis for establishing a fair profit are paramount and these should in no measure be computed from competitors' prices.

Sound selling practice was listed as the second important function of a trade association. The first step to be taken by a group such as the steel founders is to sell castings and next the obligation of individual members is to sell contracts for castings. A one bid policy, the greatest deterring factor in price cutting was emphasized and the society was urged to abide by the price per piece policy as opposed to the price per pound.

The volume error is responsible for many cases of price cutting. The effect is far reaching, as any ignorant foundry can cut the price and arduous work is required to restore such a price to a profitable level. The man who cuts prices to keep from starving was excused, but the speaker suggested that his competitors owed it to themselves in self protection to aid a foundry in such a dilemma and thus prevent a depressed price level.

Advertising was recommended to supplement efficient selling and to promote demand. Public understand-

ing and recognition of the merits and advantages of the product can be built only upon sound advertising. Advertising can be applied to any commodity, no matter how technical may be its character and the consumer or the public determines whether a steel casting or some competitive product will be used.

E. St. Elmo Lewis, Detroit, spoke on the demands of the buyers' market which obtains at this time and probably will exist as long as there is excess manufacturing capacity. He stated that with more than 3000 trade associations with a membership in excess of 450,000, individualism still is responsible for losses in business. He stressed the value of fact finding and

Group of Steel Foundrymen Attending the June Meeting of the Society

exchange of information, citing the automotive industry and the beneficial efforts of the organization which extends its co-operative effort even to the pooling of patents. He recommended the use of advertising and deprecated the tendency to reduce advertising appropriations in times of poor business. As an example of a more wise and energetic policy he told of the common brick manufacturers who through their trade association increased advertising on a falling market and by intensive effort built up a demand for the product.

The essence of selling was given as knowing what to sell and where to sell it coupled with a knowledge of the proper quota for a given selling area.

Clarence Tolan, Jr. presided at the Saturday morning session of the light steel castings division which featured two papers one on selling castings by W. H. Worrilow, Lebanon Steel Foundry, Lebanon, Pa. and the other on the complexities of steel castings by F. A. Melmoth, Detroit Steel Casting Co., Detroit. In introducing the first speaker, Mr. Tolan stated that steel foundries have given attention to making the best possible steel casting and the paramount problem today is selling the product produced.

In his address, Mr. Worrilow, stated the fundamental precept of selling which is that a sale must be mutually advantageous to buyer and seller. The seller's first thought should be of the buyer and it should be demonstrated that the buyer's credit is good and that his specifications for a steel casting which he is purchasing are reasonable and can be met. Use and satisfaction determine future sales and no foundry can profit on orders which are not repeated.

In the old days it was customary to sell castings by the pound. Then schedules were introduced which segregated the desirable and less desirable work into classifications bearing different prices, but the lump sum per pound still was maintained. Tonnage was the sole consideration and the evils which resulted from this system included low sales prices, inferior castings, poor deliveries, disputed claims and a lowering of the whole tone of the industry.

In those days salesmen knew little of their product and rather less of its uses. They readily cut prices, in many cases repeatedly upon pressure from the buyer. Today, times have changed. Steel castings salesmen should be and are taught to know their product. They have enthusiasm which is backed by a knowledge of the character of the castings they sell. The old era, when hours and days were devoted to shaving the cost of production a fraction of a cent and only minutes devoted to knocking off several cents a pound, is passing. Mr. Worrilow stressed this point, saying:

"The foundry which cuts prices . . . immediately places the fate of its business in the hands of its competitors. It must go as far as its competitors wish to take it. A fixed price and a price per piece is the cure."

In the discussion which followed, John E. Galvin, Ohio Steel Foundry Co., Lima, O., mentioned a failing of salesmen who agree too quickly with a purchaser who may claim defective castings. An error and defect claim in many cases may arise from a machinist working piecework who falls behind, claims a defect and is supported by the foreman and the purchasing agent in a claim which is not justified. H. J. Koch, Fort Pitt Steel Casting Co., McKeesport, Pa. called attention to the danger of irresponsible people in a foundry endeavoring to quote casting prices, or specifying the character of casting for a given service.

Individual costs were recommended and the single order which in many cases costs from $2.50 to $4.50 in pattern handling, pattern alterations, clerical work in entering, routing and billing and in shipping was put under scrutiny with a view to make this troublesome one time order carry its charges.

In his paper, Mr. Melmoth who recently came to the Detroit foundry from a large English steel casting plant, covered three phases of steel foundry detail, namely the metallurgical, mechanical and administrative. He contrasted a casting, which often is a complicated piece of work, with a steel ingot for rolling.

Three points were suggested in the attack upon the complexities of making steel castings. These were to obtain steel of stronger crystalline cohesion at high temperatures after solidifying to resist rupture when cast in a complicated mold. The second point was to vary the composition in some simple manner to prevent mold gases. The third was to lower the fusion point of steel by some addition which will not affect the finished casting adversely.

Mechanical problems in casting which produce cooling cracks, liquid shrinkage and gas absorption were dealt with in considerable length by the author. The administrative phases, covering costs, proper selling and the choice of executive personnel completed the paper.

During the three days of the midsummer meeting, the steel founders found opportunity for social contact and for golf. The committee in charge of the entertainment features included W. A. Faison, Atlantic Steel Castings Co., Chester, Pa.; J. T. Osler, Hubbard Steel Foundry Co., E. Chicago, Ind. and Arthur Simonson, Falk Corp., Milawukee. Golf prizes awarded were won by the following: Low gross score, T. H. Harvey, Ohio Steel Foundry, Lima, O.; Charles F. Abbott, American Institute of Steel Construction, New York, and J. E. McCauley, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; low net scores were won by J. E. McCauley; W. J. Gilmore, Ohio Steel Foundry Co., Lima, O. and R. A. Cannon, Birdsboro Steel Foundry & Machine Co. E. S. Gardner, Hartford Electric Steel Corp., Hartford, Conn., won the blind bogie prize.

SAND CONTROL
Increases Economy in the Foundry

Sand Mixing and Handling Are Important in Obtaining Best Results — Seacoal Additions Improve Surfaces

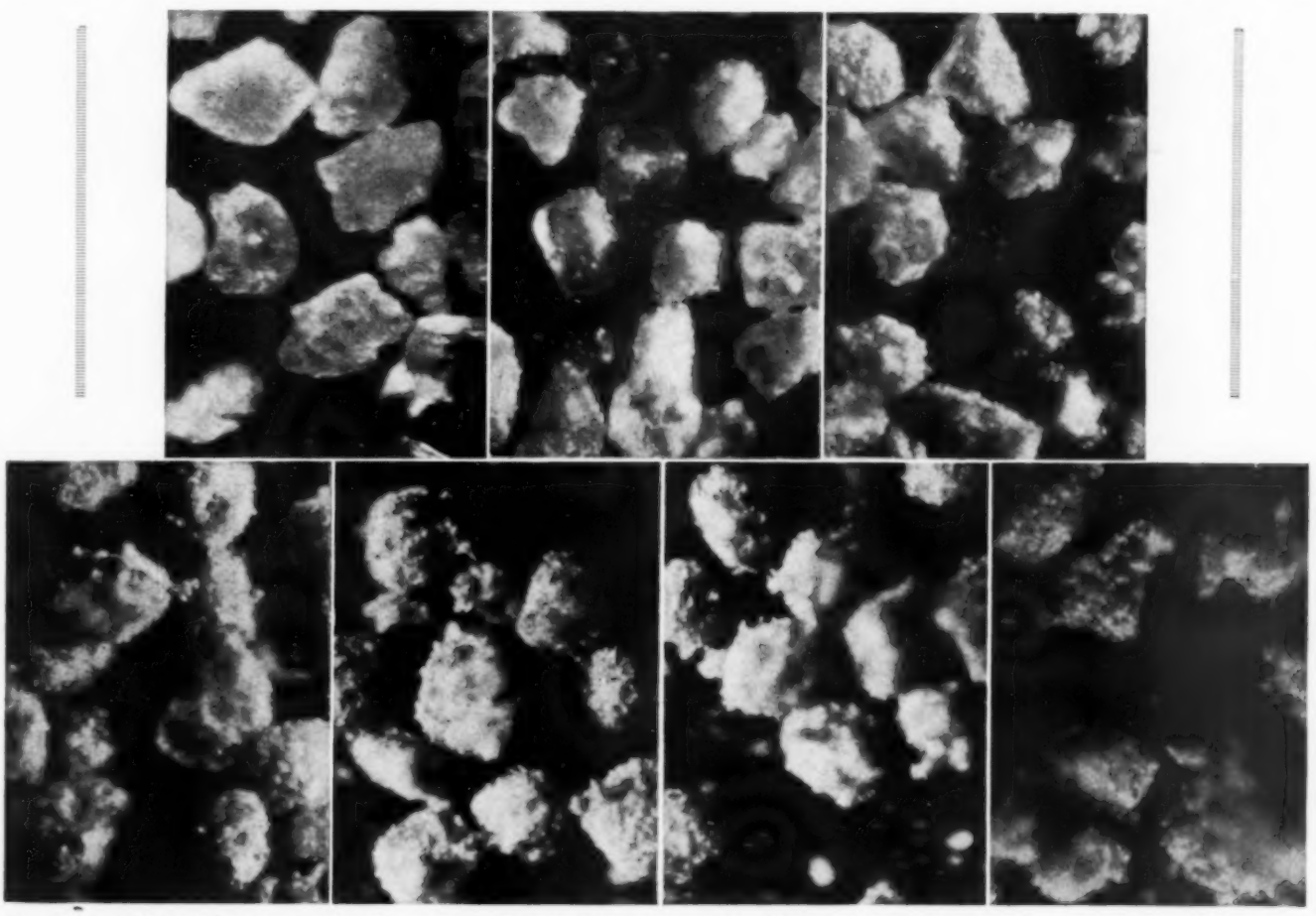
By O. E. J. Abrahamson

QUITE often a sand is condemned by the foundryman as inferior and unsuitable for his work when, with a little care in the proper mixing, the sand would serve the purpose excellently. Often, due to inefficient mixing in the foundry, the bond is not incorporated thoroughly and the sand that actually contains a considerable amount of bond will not give satisfactory results nor reveal its full bond value in testing. This is due to the fact that the bond is segregated partially into small, hard pellets, and therefore proportionately inactive. The permeability for such a sand will also be false. That is, much higher values for this function of the sand obtains than if the mixing had been more thorough.

It must be borne in mind that any sand, upon continuous use in the foundry, will have a tendency to become coarse due to the creation of compound grains, that is, baking together of small grains and bond. This, in turn, accounts for the popular belief that mulling the molding sand powders it and makes it tight, which, however, is not quite the case.

Proper mulling merely breaks up the small lumps resulting in a sand that is true to its original form and, after a further treatment by aerating devices, becomes free-flowing and *fluffy* and assumes other desirable molding properties. It also follows that with efficient sand mixing units, especially in the continuous foundry, a coarser grade of molding sand may be employed than without it, resulting in solid molds of good venting properties and consequently better castings true to the patterns.

According to calculations shown in Table XIX an average molding sand contains 885,000,000,000 grains to one cubic foot, exclusive of the bond, with a total area of 3514 square yards. Granting that only



Top Row, Left to Right—Fig. 28—*Sand Through* 100 *Mesh and on* 150 *Mesh Without Bond. Fig.* 29—*Sand With* 5 *Per Cent Bond. Fig.* 30—*Sand With* 10 *Per Cent Bond. Bottom Row, Left to Right—Fig.* 31—*Sand Through* 100 *Mesh and on* 150 *Mesh With* 15 *Per Cent Bond. Fig.* 32—*Sand With* 20 *Per Cent Bond. Fig.* 33—*Sand With* 25 *Per Cent Bond. Fig.* 34—*Sand With* 30 *Per Cent Bond*

Evaluates Seacoal

INEFFICIENT mixing of molding sands in the foundry often is the cause of poor casting results. It also leads to incorrect conclusions on bond and permeability as well as leading to opinions that mulling a sand breaks down the grains. Addition of seacoal to molding sand is one of the most economical methods of obtaining smooth surfaced castings, and in this article which is the fifth of a series on sand control, the author describes tentative methods for evaluating seacoal. The fourth article appeared in the June 15 issue.

one per cent of these grains are active as such insofar as the permeability of the sand is concerned, it still follows that intensive mixing of this sand is essential for the complete distribution of the bond, moisture, seacoal, etc.

Therefore, many modern foundries incorporate mullers, aerators, storage tanks, etc., to bring about as nearly as possible an ideal sand condition. This is particularly notable in the section of the foundry industry which produces castings that have to be smooth and clean without an excessive cleaning room cost.

Many times, however, in such a foundry a piece of sand handling equipment is condemned if it is not functioning one hundred per cent at all times and considerable criticism is offered if parts, such as muller plows or aerator pin or blades, do not last indefinitely. In the passing of up to 300 or more tons of sand per hour through a piece of machinery, it is natural that considerable wear is involved, and constant checking up is required. Ideal sand conditions in the continuous foundry always will be had if the sand treating equipment is kept in first class condition, and much grief could be eliminated if this was emphasized strongly to the organization.

Aging of a sand to bring about the complete distribution of the moisture and the full development of the bond may be entirely eliminated by repeated mulling and aerating. However, since this is an impractical procedure, especially in the production foundry, it is advisable to have storage tanks in the system for this purpose as well as to provide for a reserve supply of ready mixed sand.

To produce a clean surfaced casting the method of adding sea coal (powdered bituminous coal) to the molding sand still ranks as the most economical. The amount of sea coal to be added is governed by a great many factors, including: The manner in which the castings peel; appearance of the castings; fineness of the sea coal; volatile content of the sea coal; amount of new sand added, and the time elapsing between pouring and shaking out.

For light castings using an average sea coal, from six to eight per cent by weight of the total amount of sand added to the system or floor, including both new sand added directly and burnt core sand added indirectly from gate cores, core prints, etc., should prove sufficient.

No satisfactory rapid method for the determination of the amount of sea coal in the heap sand exists at present. However, for a matter of record it is advisable to check up on the total carbon in the sand occasionally by the combustion method.

To have some standard by which to judge the relative merits of various sea coals the following tentative method for the evaluation of sea coal was developed. Search of the literature on this subject fails to give a definite understanding of the properties that are essential in a sea coal to give a satisfactory casting at a minimum cost insofar as sea coal is concerned. The greater number of statements in regard to sea coal may be summarized as follows: "It should be fine and it should have a high volatile carbon content." Therefore, to fix more definitely the value of a sea coal on the basis of its fineness as well as its chemical analysis a study was

Plant _____ Date _____

SAND ANALYSES and LOSS REPORTS

FLOOR, number or designation

Kind or Style of Casting

CONTINUOUS SYSTEM — UNIT: TIME — No. — 7.00 9.00 11.00 1.00 3.00

Kind or Style of Casting

Moisture
Permeability (1 cm²)
Permeability (3 cm²)
Ratio
Hardness
Active Colloidal Bond
Effective Bond
Strength

Castings made — Total
Castings Lost — Total — Per cent

Cause

Castings Lost due to: Hard running; Soft running; Crush (molding); Scabbed; Gate out; Drop; Run out; Blow; Wash; Blow (not core); Cold shot; Total; Per cent

NEW SAND: Heap — Kind — Amount; Total — Amount
Facing — Total — Amount

Total Amount of SAND ON FLOOR or UNIT

Remarks

Form NA 10-27 — Signed _____

Fig. 35 — Standard Form for Indicating Sand Data and Casting Losses

Table XVIII

Comparison of Two Seacoals

No. 1 Seacoal

Through 20 mesh on 100 mesh	28.0 per cent	x	0.232	=	6.5
Through 100 mesh on 200 mesh	20.0 per cent	x	1.74	=	34.8
Through 200 mesh on 300 mesh	20.0 per cent	x	10.9	=	218.0
Through 300 mesh	32.0 per cent	x	100.0	=	3200.0
					3459.3

or 34.59 per cent fine

No. 2 Seacoal

Through 20 mesh on 100 mesh	2.3 per cent	x	0.232	=	0.53
Through 100 mesh on 200 mesh	15.0 per cent	x	1.74	=	26.1
Through 200 mesh on 300 mesh	20.0 per cent	x	10.9	=	218.0
Through 300 mesh	62.7 per cent	x	100.0	=	6270.0
					6514.63

65.14 per cent fine

made to find values for those points.

Most authors on foundry practice agree that the value of a sea coal is due to its smoking properties. That is to say the disposition of the volatile carbon to go off as soon as the iron enters the mold and be deposited throughout the mold. The carbon being highly refractory in turn prevents the sand from burning into the casting. There are also theories as to the importance of the gas-forming properties of sea coal but it is rather difficult to ascertain whether or not these theories are correct. However, it is a well known fact that by coating a mold with graphite or plumbago, a casting is produced which readily peels from the sand. Consequently, the importance of a proper distribution of carbon is apparent.

Should Be Fine

To have a uniform mixture of sand and carbon, it is quite essential that the carbon should be as finely divided as possible to give its maximum efficiency.

In the production of light tubular castings in connection with which the study was made, a satisfactory molding sand will show a permeability of 20 or over when properly tempered. This is equivalent, if the bond is assumed to be 11.0 per cent, to an effective grain size of 0.0029 inch in diameter, which again is equivalent to an effective number of grains of 1,640,000 per gram. Since a sand for this purpose will contain from 5.0 to 8.0 per cent total carbon by weight and since the greater percentage of the carbon comes from the sea coal and since by adding 5.0 per cent by weight or 10.0 per cent by volume of sea coal to a new sand, a satisfactory casting is obtained, that percentage was used for a starting point in the study.

Assuming that to obtain the most efficiency out of the sea coal there should be one particle of sea coal for every effective particle of molding sand, there should be, in the case mentioned, 1,640,000 particles of sea coal in 5.0 per cent of one gram. In other words the sea coal in question should contain 32,800,000 particles per gram. Of course the efficiency of the sea coal will be still greater if the fineness of the sea coal is greater, and less efficient naturally if the sea coal is coarser than previously stated.

The number of particles on each of the more common sieves employed in the grading of sea coal have been calculated as follows: Through 20 mesh on 100 mesh — 160,000 grains per gram; through 100 mesh on 200 mesh —1,200,000 grains per gram; through 200 mesh on 300 mesh — 7,500,000 grains per gram, and through 300 mesh—69,000,000 grains per gram.

Calculates Screen Efficiency

For practical purposes and to eliminate microscopic investigations which would merely complicate matters the material that passes the 300 mesh sieve has been called 100 per cent efficient. If the efficiency of the various sieves are recalculated on the basis of the number of particles retained by each one, the following factors are obtained: On 100 mesh—0.232 per cent; through 100 mesh on 200 mesh—1.74 per cent; through 200 mesh on 300 mesh—10.9 per cent, and through 300 mesh—100.0 per cent.

These figures then will be the percentages of efficiency of each sieve and if these factors are used in calculating the percentage of fines of two sea coals as shown in Table XVIII, it may be seen that sea coal No. 1, on the basis of its fineness, is only half as efficient as sea coal No. 2 or, to be more exact, No. 2 is equivalent to 1.885 times No. 1.

To fix still further the evaluation factor of sea coal, the percentage of volatile combustible matter as well as the percentage of ash should be

Table XX

Formulas for Grain Size and Screen Data

$$\text{Number of grains} = \frac{\text{weight in grams}}{\text{Sp. Gr.} \times 4 \pi \times R^3 \over 3} = \frac{0.73493 \times a}{d^3}$$

where a = weight in grams
d = diameter in centimeters

DATA ON STANDARD SAND SIEVES

Sieve No.	Opening Inches	Average Grain Diameter—Inches	Number of Grains Per Gram
Through 3	0.250	.....	.....
on 6	0.131	0.1900	6.5
10	0.065	0.0980	47.7
20	0.0328	0.0164	383.6
35	0.0164	0.0246	3010
65	0.0082	0.0123	24,082
100	0.0058	0.0071	125,300
150	0.0041	0.00495	371,200
200	0.0029	0.0035	1,042,500
270	0.0021	0.0025	2,870,400
		0.0020	5,606,250
Pan (avg.)		0.000683	141,089,750
Pan (Note statement on colloids in previous article)		0.0001	44,850,000,000

Table XIX

Calculates Number of Sand Grains

The average percentages of pan material and bond substance in one set of experimental sand mixtures were found to be 13.7 and 13.8, respectively.

Careful measurements of the grains on the pan (less than 300 mesh) for that average molding sand after the bond had been removed by the ammonia flotation process as outlined in a previous article showed that 25 per cent had an average grain diameter of 0.0015-inch and that 75 per cent had an average grain diameter of 0.000625-inch.

Since sand grains 0.0015-inch in diameter show a grain count of 13,289,000 grains per gram and sand grains 0.000625-inch in diameter show 183,690,000 grains per gram, then

25 per cent of 13,289,000 = 3,322,250 grains, and
75 per cent of 183,690,000 = 137,767,500 grains, or

a total of 141,089,750 grains per gram

which in turn is equal to an average effective grain diameter of 0.000683-inch.

Since the amount of pan material exclusive of the bond, was equal to 13.7 per cent, it follows that one gram of the sand in question contains,

13.7 per cent of 141,089,750 or 19,300,000 grains (round numbers) counting only the grains on the pan from 0.0001-inch diameter and larger.

The number of grains retained by the various screens down to the 300 mesh is so small in proportion that they may be left out in a study of this kind. However, an average sand such as the one under consideration has a total of 220,500 grains per gram left on the various sieves down to the 300 mesh.

The total number of grains per gram, exclusive of the bond, therefore is 19,520,500.

Assuming that one cubic foot contains 100 pounds of that average sand, the total number of grains will be as follows: 100 x 453.59 x 19,520,500 or 885,000,000,000 grains per cubic foot.

Since the average effective diameter of the grains in a sand with 13.8 per cent bond and 19,520,500 grains is 0.003197 centimeters or 0.00126-inch, it follows that the surface area of the grains in one gram is 626.99 square centimeters, and in one cubic foot 100 x 453.59 x 626.99 or 28,439,600 square centimeters or 3401 square yards.

incorporated. Since the percentage of volatile combustible matter is a positive adjunct to the efficiency of the sea coal it is added to the fineness percentage, while the percentage of ash is a negative and therefore subtracted from the sum of the two former.

Sea coal	No. 1	No. 2
	Per Cent	
Fineness	34.59	65.14
V. C. M.	26.59	33.30
	61.18	98.44
Ash	6.90	9.75
Efficiency factor	54.28	88.69

From these two sets of calculations it will be seen that sea coal No. 2 is 38.8 per cent more efficient than No. 1 or, if translated on a tonnage basis, 2000 pounds of No. 2 is equivalent to 3,270 pounds of No. 1.

Should Keep Records

The fullest advantage of sand testing and sand control may be had only by keeping complete records not only of the sand data obtained by testing but also of production, losses, surface condition of castings, amount and kind of new sand (whether natural or manufactured), the amount of sea coal or other facing compounds, mixing time, etc.

The importance of having not only proper mechanical sand handling in a modern continuous foundry but also technical control of the sand in the system is apparent when the number of times that the sand is turned over in the course of a day—as many as 50—is considered.

This same sand, if in a floor foundry, would be used only once a day and any change taking place in the sand due to one cause or another would be noticed and corrected in a day or two. In a continuous foundry, on the other hand, the sand may be changed in a matter of an hour and it is therefore of utmost importance that the proper equilibrium be maintained.

This may be accomplished by frequent laboratory tests which may avoid serious trouble due to too dry, too wet, too weak, too strong, too tight or too open a sand. However, after an equilibrium is established it is actually easier to maintain a sand in a continuous system at a definite point than it is to control a whole floor foundry with its many heaps and great amount of sand in use.

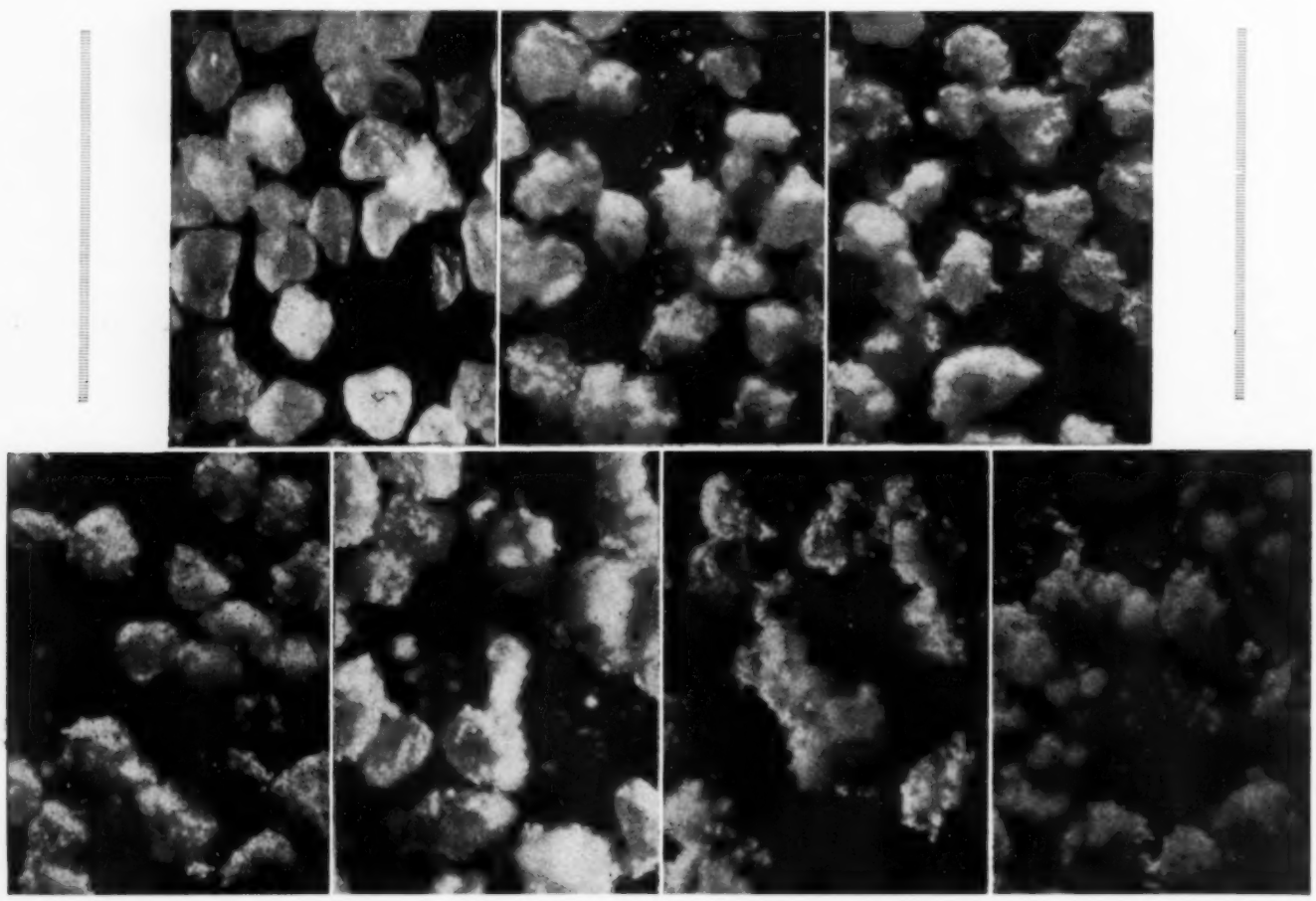
In a continuous system it is therefore advisable to make several tests daily, the actual number depending on a great many circumstances, while in a floor foundry (especially of the production type) a test every other day or in some cases even once a week should suffice, with the exception of moisture which should be determined daily.

On the report blank shown in Fig. 35 which is used for recording the information essential to the proper functioning of the sand laboratory, there is a line reading "Effective bond." This value for a molding sand is obtained by reading the permeability ratio on the average ratio curve shown in Fig. 14 which was presented in the April 15 issue of THE FOUNDRY.

Since the effective bond thus found depends to a great extent on the percentage of moisture, it may be employed to great advantage by the sand analyst. It has been determined definitely that for light casting molding practice, the effective bond should be less than the active bond, while for medium and heavier castings the effective bond should be higher than the active bond.

Has Better Properties

By keeping the effective bond lower than the active bond it means that the percentage water used has been less than necessary to get the full effect of the active bond present. This results in a better molding proposition, freer flowing sand, smoother castings, less loss from cold shuts, etc. In the case of heavier work the situation is somewhat different. Here ex-



Tow Row, Left to Right—Fig. 36*—Sand Through* 150 *Mesh and on* 200 *Mesh Without Bond. Fig.* 37*—Sand With* 5 *Per Cent Bond. Fig.* 38*—Sand With* 10 *Per Cent Bond. Bottom Row, Left to Right—Fig.* 39*—Sand Through* 150 *Mesh and on* 200 *Mesh With* 15 *Per Cent Bond. Fig.* 40*—Sand With* 20 *Per Cent Bond. Fig.* 41*—Sand With* 25 *Per Cent Bond. Fig.* 42*—Sand With* 30 *Per Cent Bond*

perience shows that when the effective bond is higher than the active bond, in other words, when the sand is over tempered, there is less trouble from scabbed castings, dirt washes and the like.

Experience also shows that the best results insofar as the finish of the casting is concerned are obtained with the permeability for light casting sand below 25 and the active bond from 9.0 to 13.0 per cent. For medium to heavy work permeabilities of from 50 and higher with bond from 7.0 to 10.0 per cent are recommended.

However, since there is a difference in the nature of the bond in different sands as well as a different grain structure, whether the sand is a natural one or manufactured, and since the manner in which the molds are made and handled varies considerably, each foundry should establish independently what bond and permeability it should maintain in its sand heaps or sand systems for the production of the best castings possible.

Show Steps in Foundry Practice

AN EXHIBIT showing foundry practice, and materials and tools employed in the manufacture of small iron castings has been opened at the Newark, N. J., museum, in connection with a display of 200 electrically operated mechanical models which demonstrate mechanical principles of power transmission. The display of foundry process is an educational feature attracting large numbers of technical students and will be continued into the fall. Operations in the manufacture of small castings, from the pattern blue print to the finished material, are described minutely.

Double grooved pulley and cam wheel castings are the units selected to demonstrate foundry practice. Finished products are illustrated in operation as machine parts. Patterns are shown for the plate, hub and rim of the cam wheel. Benjamin Jarvis, Inc., Newark, loaned the exhibits for the pattern display while the Sacks-Barlow Foundries, Inc., Newark, sponsored the casting exhibits.

The exhibition is divided in two sections, one depicting the designing and production of the pattern and core box, while the second, under the heading. "The Making of a Cast Iron Casting," starts with the molding sand and follows the foundry operations through to completion. Small details in the art of iron casting are not overlooked. Special attention is given to the importance of sands, parting compounds, wood shrinkage tendencies, binders and fuels.

As the first step in planning a double grooved pulley, a rough square block of mahogany is shown with the preliminary sketch and blueprint. Various steps in the making of the core box and pattern are depicted. Photographs of the lathe turning operations are displayed and finally the finished pattern is exhibited. In turning the cam wheel pattern, it is explained that the rim segment is laid out along the grain of the wood to guard against shrinkage. All three sections of the cam wheel pattern are shown in parts.

In the castings section, importance of molding sand is stressed. A sample of molding sand is shown and its properties described. The match, partly filled with mixture of sand, linseed oil and litharge, packed firmly to the parting line of the patterns is shown with rammer, and parting powder. Use of the latter is illustrated in placing the drag on the match. Molding operations follow in order, including filling the mold, use of the cope, forming the sprue and the mold ready to have the cope taken off. Uses and importance of graphite are included.

Considerable space and detail is devoted to the core used to form the internal space in the double grooved pulley. Importance of binder is stressed. Baking of the core is explained. Small hand tools used in the various operations are displayed. Coke, pig iron, fire clay, sand and cupola mixtures are shown. The display also illustrates, pouring, a quarter section of the mold showing how the iron fills the impression, rough castings with sand removed, principles of sandblasting and castings which have been ground. The finished castings are shown in action at the mechanical movement exposition.

The exhibit of machine models, made by W. M. Clark, South Orange, N. J., is a gift of Louis Bamberger to the museum. The working models are displayed on 10 large boards, each containing 12 panels, upon which are mounted one or more of the mechanical movements. The models range in intricacy from the basic mechanical devices such as the inclined plane, lever, screw and wedge to such complicated applications as piano action, and automobile engine and a triple expansion steam engine. Workings of many familiar household devices and the complex mechanisms of the automobile are made comprehensible. Files and current copies of THE FOUNDRY, *Steel*, *Abrasive Industry*, *Machine Design* and other Penton publications, are displayed in the technical index booth.

Standards Year Book Is Published by A. S. A.

The American Standards association, New York, has published its 1930 year book of American standards. Important progress in standardization work affecting mechanical, electrical, railways, mining and other major American industries is reported in the book.

Among the high spots of the standardization movement during the past 12 months the year book notes the underwriting by industry of $500,000 for the promotion of national standardization during the next three years; the affiliation of the American Standards association with the national standardizing bodies of 20 other nations; increased recognition of the value of standardization in foreign trade; and the completion of an agreement between the association and the bureau of standards.

A list of the publications of the association is included, and the general scope of the activities of the group is covered. Copies of the *American Standards Year Book* may be obtained free by writing to the association, 29 West Thirty-ninth street, New York.

Organization Meeting Is Held

The newly elected officers and executive committee of the Newark Foundrymen's association held their organization meeting June 16, and formulated plans for the coming year. Five meetings were arranged to be held in the evening on the following dates: Oct. 22, Dec. 3, Jan. 28, March 25, and May 27.

A program committee was appointed as follows: H. L. Edinger, Barnett Foundry & Machine Co., Irvington, N. J., chairman; J. L. Carter, Sacks-Barlow Foundries, Inc., Newark, N. J.; W. H. Mantz, Atlas Foundry Co., Irvington, N. J.

The committee on revision of by-laws is: P. R. Van Duyne, Meeker Foundry Co., Newark, N. J., chairman; J. A. Williamson, Isbell-Porter Co., Newark, N. J.; V. Vandervoert, Watson Machine Co., Paterson, N. J.

The membership committee is: F. D. Campbell, Eastern Corp., Graybar building, New York, chairman; E. M. Taggart, Paxson-Taggart, Inc., Philadelphia.

R. B. Flynn, F. L. Smith Co., Elizabeth, N. J., will have charge of reports to business papers, etc.

The bureau of standards has issued commercial standard CS-7-29 relating to standard weight malleable iron or steel screwed unions, giving data on material and workmanship, general requirements, and detailed requirements including the dimensions of the unions. Copies of the standard may be obtained from the government printing office on request, for 5 cents.

A.S.T.M. Has Busy Week

Extra Session Held to Permit Presentation of the Many Reports and Papers — Propose Changes in Castings Specifications

THIS year's annual meeting of the American Society for Testing Materials held at Atlantic City, N. J., from June 23 to 27, featured one of the heaviest programs that ever has been arranged, and included 130 items of which 73 were papers. The heavy schedule is attributed to the preparation of the new edition of the triennial book of standards which will be published this year.

Attendance also exceeded that at any previous meeting with over 1100 registered. Committee A-3 on cast iron made several proposals of importance to the foundry industry which include the recommendation that gray iron castings be referred to by class, such as pipe wheel, etc., omitting reference to quality; changes in the standard specification for high test gray iron making the minimum load in the transverse test 2500 instead of 2250 pounds, and the minimum tensile strength 33,000 instead of 28,000 pounds. It also was recommended that the tentative specifications for valves, flanges and fittings be made standard.

Committee A-7 on malleable castings recommended that the present specification yield point be increased from 30,000 to 32,500 pounds per square inch. Committee A-1 on steel proposed a tentative specification for austenitic manganese-steel castings. It also was stated that after the meeting a comprehensive review of the present knowledge of fatigue of metals, and a new revised and amplified list of nonferrous alloys with their chemical compositions and physical properties will be published.

Society's Activities Are Wide

PRESIDENT T. D. Lynch, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. called the opening session to order at 2 p.m. Tuesday. After a few remarks covering the important features of his administration, he introduced C. L. Warwick, secretary-treasurer and chairman of the papers committee. Mr. Warwick ascribed to the approaching triennial volume of standards the intensified activity of this convention, which is shown in a total of 130 items of which 73 are formal papers and the remainder committee reports. He reviewed the tremendous growth and importance of the work of the society, the impetus given to all forms of technical knowledge, and particularly the more recent successful work in expanding the use and service of standards and methods for testing. One example is found in a publication which includes selected standards of value to engineering students. A first edition of this work already has sold 1000 copies and an edition of 2000 books will be prepared for the fall school term.

H. F. Moore, University of Illinois, Urbana, Ill. as chairman of the committee on correlation of research, reported that after the annual meeting a critical review in the light of the reports given at the convention will be published. Professor Moore spoke of the many joint projects which the American Society for Testing Materials is carrying on, noting in particular the alloys of iron research which is being handled under direction of the Engineering Societies Research board and the American Institute of Mining and Metallurgical Engineers. This will make available all reliable information in all literature giving data on iron and its alloys and show the way to increase the precision of data needed for modern industrial practice.

Will Issue New Standards

T. R. Lawson, Rensselaer Polytechnic Institute, Troy, N. Y., chairman of the committee on standards predicted that the 1930 edition of the standards of the society will include 579 items, while the 1916 publication had a total of 136. This pictures the valuable contribution of the society toward engineering progress. The coordination of the work of the American Society for Testing Materials with other organizations and agencies without hampering interference of duplication of effort is a splendid accomplishment.

W. H. Fulweiler, United Gas Improvement Co., Philadelphia, chairman of committee E-1 on methods of testing presented a brief abstract of his report in which he mentioned that the outstanding work was the organization of a technical committee on the presentation of data. Other points mentioned were the formation of a section on elastic strength of materials under F. B. Seely, University of Illinois, Urbana, Ill.; the resume of progress made in impact testing as reported by J. M. Lesells, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and the appointment of L. T. Work, Columbia university, New York, as chairman of the technical committee on size and shape. The meeting was closed with the presentation of the report of committee E-8 on nomenclature and definitions by Cloyd M. Chapman, New York, chairman of that committee.

The annual Edgar Marburg lecture was presented by Dr. E. C. Kenneth Mees, Eastman Kodak Co., Rochester, N. Y., Wednesday afternoon, on the subject of color and its measurement. Following the lecture, the Charles B. Dudley medal was awarded to J. R. Townsend, Bell Telephone Laboratories Inc., New York; W. A. Straw, Western Electric Co. Inc., Chicago, and C. H. Davis, American Brass Co., Waterbury, Conn., in recognition of the merits of their joint paper entitled, "Physical Properties and Methods of Tests for Some Sheet Nonferrous Materials" which was presented at the 1929 annual meeting of the society.

Chairman H. F. Moore opened the business session which was held Wednesday evening. C. L. Warwick, secretary-treasurer of the society presented the annual report of the executive committee which points out the increase in membership over the past year, the financial position of the so-

ciety, and the work that the group has accomplished during the past year. It also was announced that next year's meeting will be held in Chicago with the Stevens hotel as headquarters.

President Lynch in his annual address said that to increase the usefulness of raw materials it was necessary to have adequate knowledge of their properties. Management must not fail to give due support to research work as it leads to progress. Due to the rapid advances in engineering sciences the members of the society should ever be alert to be prepared for the future.

H. M. Boylston announced the results of the letter ballot for the election of officers for the ensuing year by which K. G. Mackenzie, Texaco Co., New York, was elected president, and Cloyd M. Chapman, New York, vice president. Five new directors also were elected and include F. H. Jackson, United States bureau of public roads, Washington; Zay Jeffries, Aluminum Co. of America, Cleveland; G. A. Reinhardt, Youngstown Sheet & Tube Co., Youngstown, O.; H. N. Van Deusen, Bell Telephone Laboratories Inc., New York, and H. H. Quimby, Philadelphia.

Cast Iron Attracts Attention

TWO papers were presented in conjunction with the report of committee A-3, which was submitted at the Tuesday evening meeting under the chairmanship of T. R. Lawson, Rensselaer Polytechnic institute, Troy, N. Y. One paper was entitled, "Effect of Section on Physical Properties of Cast Iron," by A. L. Boegehold, General Motors Corp., Detroit. The second paper was on, "Comparison of the Physical Properties of Different Sections of Cast Iron and of the Standard Arbitration Test Bar," by M. V. Healey, General Electric Co., Schenectady, N. Y., which was presented by J. A. Capp of the same firm. The comparison was made between regular arbitration tests bars and a special casting with four different wall thicknesses ranging from ½ to 4 inches. The tests showed a gradual decrease in strength as the section increased except for the ½-inch which did not line up with the others. Also no definite relation between wall thicknesses and the arbitration bar could be established from the tests. H. Bornstein, Deere & Co., Moline, Ill., in commenting upon the papers said that he found through tests carried out in his plant that there was a relation between brinell hardness, tensile strength, transverse strength, and the fracture, and that his firm had set up a specification including the relation of brinell and strength for certain castings.

KENNETH GERARD MACKENZIE was born in New York, Feb. 4, 1887, and received the degree of bachelor of philosophy from Yale university in 1907 and the degree of master of science in 1909. Since 1911 he has been consulting chemist of the Texaco Co., New York. From 1925 to 1927 he was a member of the executive committee of the American Society for Testing Materials, and vice president from 1928 to 1930. Mr. Mackenzie in addition to his membership in the society is a member of the Chemist's club, Franklin institute, Institution of Petroleum Technologists of Great Britain, the Chemical Society of London, and other chemical and technical organizations.

Revise Standards

Mr. Bornstein then read his report in which it is stated that the committee recommends that cast iron be designated according to the class of work such as pipe, wheels, etc., and that terms referring to quality such as high test be abandoned. The committee also recommends that the tentative specifications for chilled tread cast iron wheels be revised and continued as tentative, and that the requirements on high test cast iron be revised in that the minimum load be changed from 2250 to 2500 pounds in the transverse test, and from 28,000 to 33,000 pounds per square inch in the tensile test.

In submitting for advancement from tentative standard to standard, the specifications for gray iron castings for valves, flanges and pipe fittings, considerable discussion was offered. J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala., speaking against the adoption, said that he believed that the proposed bar for testing was not the standard of the society; that the phosphorus requirement of 0.75 per cent was too rigid for the lower grade iron of 21,000 pounds per square inch tensile, and too high for the 30,000 pounds per square inch tensile strength iron. Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va. presented a discussion on behalf of C. D. Mathews, U. S. Cast Iron Pipe Co., Burlington, N. J., in which objection also was made to the proposed bar; the making of an extra bar for tensile test; the phosphorus requirement and the proposal to specify the tensile strength with the transverse test optional. Replies to the various criticisms were made by Mr. Bornstein; L. W. Spring, Crane Co., Chicago; and J. W. Bolton, Lunkenheimer Co., Cincinnati. It was pointed out that the American Society

CLOYD MASON CHAPMAN was born in Akron, O., Nov. 5, 1874, and prepared for his university career at Buchtel college, Akron. He studied mechanical engineering at Cornell university, interrupting his course to serve as engineer officer in the navy during the Spanish-American war. After the war he entered the employ of Thomas A. Edison, serving as assistant in his West Orange, N. J. laboratory, and also in mining exploration and development work in Canada, New Mexico, and Australia. In 1905 he entered the employ of Westinghouse, Church, Keer & Co., New York, as construction engineer. Since 1920 he has practiced as a consulting engineer with offices in New York.

for Testing Materials does not require the use of the arbitration test bar as standard for any specification; that the bars suggested can be made easily in green sand as used for the castings; and that since valves and fittings were designed according to Barlow's formula based on the tensile strength, it is necessary to provide means to determine the tensile strength. Following the discussion, it was voted to submit the specification to a letter ballot of the members as specified in the rules of the society.

Committee A-7 on malleable castings through its secretary Enrique Touceda, Malleable Iron Research institute, Albany, N. Y., recommended that the yield point as designated in the present standard specification be changed from 30,000 to 32,000 pounds per square inch. The report of committee A-6 on magnetic properties was presented by Thomas Spooner, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., chairman.

A. C. Seletsky, Johns Hopkins university, Baltimore, then presented an abstract of a paper by himself and W. B. Kouwenhoven, also of Johns Hopkins, entitled, "The Unbalanced Alternating Current Bridge for Magnetic Analysis" which described a method for testing ferrous materials of varying cross sections magnetically.

The session closed with the presentation of the report of committee E-4 on metallography by H. C. Boynton, John A. Roebling's Sons Co., Trenton, N. J., chairman. The committee recommended a proposed revision of recommended practice for thermal analysis of steel, and a revision of standard rules governing the preparation of micrographs of metals and alloys, including recommended practice for microphotography.

Study Fatigue and Corrosion

FATIGUE and corrosion of metals was the subject of a session which was held Thursday morning with F. O. Clements, General Motors Corp., Detroit, as chairman. In the report of the research committee on the fatigue of metals, H. F. Moore, chairman, stated that after the meeting a comprehensive review of the present knowledge of the fatigue of metals as presented in the world's technical literature will be published by the society. J. B. Kommers, University of Wisconsin, Madison, Wis., stated in his paper on the effect of under-stressing open-hearth iron and cast iron, that the more homogeneous open-hearth iron only had its strength increased 10 per cent while the non-homogeneous cast iron increased about 31 per cent. R. F. Passano, American Rolling Mill Co., Middletown, O., and H. F. Moore gave discusions.

"Fatigue Tests of Fillet Welds," by R. E. Peterson and C. H. Jennings, both associated with the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was presented in the absence of the authors by J. M. Lesells of the same firm. D. J. McAdam Jr., U S.. naval experiment station Annapolis, Md., presented a paper on the effect of stress and cycle frequency on the rate of corrison damage of ordinary steels, corrosion resistant steels, monel metal and aluminum alloys.

Shows Test Results

In the absence of J. H. Gibboney, chairman of committee A-5 on corrosion of iron and steel, the report was read by H. E. Smith, New York Central Lines, New York. The report contains additional failures of test sheets at Annapolis, Md., and results of the total immersion corrosion tests at Annapolis, at Pittsburgh and at Washington.

Report of committee B-3 on corrosion of nonferrous metals and alloys was presented by H. S. Rawdon, bureau of standards. The committee is actively engaged in obtaining materials for tests and outdoor exposures. "A Study of the Error of Averages and its Application to Corrosion Tests," was the subject of a paper by C. H. Humes, R. F. Passano, and Anson Hayes, all of the American Rolling Mill Co., Middletown, O. The report of the sectional committee on specifications for zinc coating of iron and steel was presented by J. A. Capp, General Electric Co., Schenectady, N. Y., and the session closed with, "Some Observations on the Outdoor Atmospheric Corrosion of Protective Zinc Coatings," by C. L. Hippensteel, C. W. Borgmann and F. F. Farnsworth, Bell Telephone Laboratories Inc., New York.

Observe Properties of Steel

STEEL was the subject of a session held Wednesday morning with A. A. Stevenson, Ardmore, Pa., presiding. J. B. Young, Reading Co., Reading, Pa., chairman of committee A-1 on steel presented the report of that committee in which two new tentative standards, several tentative revisions of standards, advancement of three tentative standards to standards, and the adoption of tentative revisions to standards are proposed. The two new proposed standards are for austenitic steel castings and for open-hearth iron plates of flange quality.

E. E. Thum, New York, pointed out in his paper, "New Manganese Alloy Steels," that a considerable quantity of steel containing 1.25 to 1.75 per cent manganese are being consumed as rail steel, high strength structural steel, castings, forgings, etc. Bradley Stoughton, Lehigh university, Bethlehem, Pa., in discussing the paper advanced the theory that the reason for the high strength of medium-manganese steels is due to the sorbitic rather than the pearlitic structure formed. H. H. Morgan, R. W. Hunt Co., Chicago, cautioned against the too hasty application of medium-manganese steel for any and all purposes.

Alloy Steels Discussed

"The Relative Merits of Some Different Alloy Steels with Respect to Certain Mechanical Properties," by Bradley Stoughton and W. E. Harvey, both of Lehigh university, Bethlehem, Pa., which was presented by Mr. Stoughton gave the results of some work to determine a merit value for different types of alloy steels. In the discussion A. B. Kinzel, Union Carbide and Carbon Laboratories, Long Island City, N. Y., pointed out that merit value or quality factor must be related to service application, and not just obtained indiscriminately. Others entering into the discussion included E. E. Thum, H. J. French, International Nickel Co., Bayonne, N. J.; J. M. Lesells, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and Jerome Strauss, Vanadium Corp. of America, Bridgeville, Pa.

Report of committee A-10 on iron-chromium, iron-chromium-nickel and related alloys was then presented by Jerome Strauss, and was followed by a paper by Norman B. Pilling, International Nickel Co., New York, on the effect of increasing the nickel content of the austenitic iron-chromium-nickel alloys in the 18 per cent chromium, 8 per cent nickel composition. Two written discussions by J. A. Mathews, Crucible Steel Co. of America, New York, and W. M.

Mitchell, Republic Steel Corp., Massillon, O., were read. Other discussions of the paper were presented by Jerome Strauss, Howard Scott, and P. H. Brace, both of the Westinghouse Electric & Mfg. Co.

The meeting was closed with reports of committees including those on research by M. O. Withey, University of Wisconsin, Madison, Wis.; heat treatment of iron and steel by H. M. Boylston, Case School of Applied Science, Cleveland, and on standardization of dimensions and material of wrought-iron and wrought steel pipe and tubing by H. H. Morgan, R. W. Hunt Co., Chicago.

Nonferrous Committees Report

REPORTS of the several committees on nonferrous metals and the presentation of four papers on that subject were the features of the nonferrous metal session held Thursday evening under chairmanship of W. R. Webster, Bridgeport Brass Co., Bridgeport, Conn. J. A. Capp, General Electric Co., Schenectady, N. Y., presented the report of committee B-1 on copper wire. This was followed by a report of committee B-2 on nonferrous metals and alloys by W. H. Bassett, American Brass Co., Waterbury, Conn.

D. L. Colwell, Stewart Die Casting Corp., Chicago, discussed the development of zinc-base die casting alloys stated that by using pure zinc excellent results could be obtained from zinc-aluminum alloys. He also mentioned that immersion tests in paraffine baths at 70 and 95 degrees for 10 to 20 hours and the Charpy impact test are good indicators of die casting alloy strength properties. Properties of silver solders and methods of use with different materials were described by R. H. Leach, Handy & Harman, Bridgeport, Conn.

Committee B-4 on electrical-heating, electrical-resistance and electrical-furnace alloys reported through Dean Harvey, Westinghouse Electric Co., East Pittsburgh, Pa., chairman. E. J. Dix Jr., Aluminum Co. of America, New Kensington, Pa., presented the report on light metals and alloys which included a tentative specification for magnesium-base alloy sand castings. The report of committee B-5 on cast and wrought copper and copper alloys was given by C. H. Mathewson, Yale university, New Haven, Conn. G. H. Clamer, Ajax Metal Co., Philadelphia, in the report of the special committee on promotion of general use of specifications for ingot copper alloys stated that probably it will be possible to reduce the present 599 alloys to about 15.

In a paper, "The Effect of Small Additions of Nickel to a Bearing Bronze," by Clair Upthegrove, D. Wilson, and F. W. Ryan, University of Michigan, Ann Arbor, Mich., it was shown that the hardness of the alpha and delta constituents reach a maximum at 5 per cent nickel in an 85 copper-15 ton bearing bronze.

In the general report of committee B-2 it was mentioned that a change has been made in the status of the subcommittee on die cast metals and alloys. The work formerly carried on by that group now will function under committee B-6 on die cast metals and alloys. It also was stated that a revision and amplification of Campbell's list of alloys originally published in 1922 has been made. The new list will contain data on the physical properties of some of the typical alloy compositions.

Technical Control Is a Necessary Factor

At a recent meeting of the St. Louis District Foundrymens club, J. W. Snelson, Century Electric Co., St. Louis, discussed methods for insuring a uniformly high grade cast iron. He directed attention to the fact that although all technicalities are eliminated from the discussion, or application of a method, the success of the method still depends upon doing the job just right.

There is little difference between results obtained by practical means and those obtained by scientific control. With scientific control, one knows exactly what has been accomplished and the process can be repeated in full confidence. Results obtained by practical means may leave one more or less in the dark as to whether it can be done again, or just how it happened.

Careful chemical analysis of materials used in the foundry, scientific cupola and sand control, plus a good cost system, will not settle all the foundry troubles, nor will the remedy be found in total or partial neglect of this side of the question. There should be a happy medium since it is obvious that no success can be assured by following one policy to the exclusion of the other.

A complete understanding of the theory of combustion, plus a knowledge of the fundamental principles of metallurgy as regards the physical structure of the iron is of vastly more importance than mere chemical analyses. A realization of this fact by the operator will give impetus to gray iron foundry progress. Operation of a modern automobile foundry has been reduced as far as possible to a scientific basis. Much of the old rule-of-thumb has been eliminated as a result of the study of the fundamental principles underlying foundry business.

The practical man is valuable and indispensable in the foundry, but his value would be increased greatly if more consideration were given to the technical side of the problems he encounters daily. Select the really successful foundryman of today and you will find a man with a combination of technical training and practical experience.

Only scientific control will tell the foundryman when his coke is good, his sand is just right in moisture, bond, grain size and permeability, his molten metal as it flows from the spout is of a quality to produce proper results.

Coke possessing a burning rate during a test of 2 to 2.5 minutes for 250 degrees Fahr., will melt iron at a fast rate and heat it to a temperature of 2700 degrees with a smaller amount than required with a coke showing a slower burning rate. Experience in melting iron for small castings with sharp corners and thin sections has shown that it is necessary to use 225 to 250 pounds of coke between charges, per ton of iron.

Equipment Makers To Form Groups

Members of the Foundry Equipment Manufacturers association, at a recent meeting held in Cambridge Springs, Pa., gave careful consideration to the group organization plans in the light of recent business developments. It was decided unanimously that the association should proceed at once with the organization of groups covering the various divisions of foundry equipment. The sand preparation and material handling group held a preliminary meeting in Chicago on June 10 and a second meeting of that group and meetings of the molding machine and sandblasting and dust collecting group will be held at the Hotel Cleveland, Cleveland, on Tuesday, July 22. At that time permanent organizations for the various groups will be perfected.

John C. Woodison, who has been vice president and secretary of E. J. Woodison Co., Detroit, foundry equipment, foundry facings, etc., will succeed the late Edward J. Woodison as president.

Briquetting Borings
Reduces Gray Iron Melting Costs

By Fred J. Walls

MANY methods have been devised during the past decade for binding together cast iron borings or chips that they might be used economically as melting-scrap in the cupola. These methods include the rusting process by use of common salt, sal-ammoniac, etc.; the cementing process by use of water glass, portland cement and other binders; and the canning process by sealing in sheet metal containers. Few, if any, of these methods have proved exceptionally successful, due to cost of materials and labor involved, and primarily to excessive oxidation losses encountered in high temperature zones within the cupola.

Develop Large Machine

A few years ago the Southwark Foundry & Machine Co., Philadelphia, developed a large automatic semihydraulic press capable of exerting a pressure exceeding 600,000 pounds, and installed one of these machines in the plant of Dodge Bros. Inc., Detroit, for briquetting cast iron borings. In September, 1928, the Wilson Foundry & Machine Co., Pontiac, Mich., after considerable experimenting and investigations of the results at Dodge Bros., ordered one of these machines. The cost of the machine and equipment as installed was as follows:

300-ton briquetting machine Includes freight to Pontiac, Mich.	$39,158.15
Building: Includes foundation for machine, air, water, heating, lighting, drains, etc.	2,842.35
Erection of machine: Includes labor, engineering services, guarding, etc.	1,387.85
Conveyors: Includes power lines, motors, control equipment, screen, storage bins, etc.	24,338.11
Total cost of installation	$67,726.46

Gives Cost Figures

FROM time to time various methods have been proposed for agglomerating gray iron borings and chips into compact masses suitable for remelting in the cupola. Of the methods suggested it appears to be conceded that the best results are obtained by compacting the borings under enormous pressures into briquets which withstand rough usage without disintegrating. That is borne out from the experience of the author. In this article he also includes some cost figures and results obtained in melting varying amounts of briquets in the cupola. This article is abstracted from a paper presented on behalf of the American Foundrymen's association at the annual meeting of the Institute of British Foundrymen held in Middlesbrough, England, June 17 to 20. The author is chief metallurgist, Wilson Foundry & Machine Co., Pontiac, Mich.

The machine is driven by a single 75 horsepower motor running at 600 revolutions per minute direct connected through gears and reduced to 18 revolutions per minute which produces 18 briquets per minute. The briquets are 4 inches in diameter, about 3 inches long and weigh on an average of 7 pounds each. This gives a production rate of 3.78 net tons per hour.

Conveyor is Important

Since the conveying systems represent about 36 per cent of the total cost of the installation, they will be described briefly. The cast iron borings are dumped through gratings in the floor of the machine shop into a 40-ton storage hopper from which they are fed into a bucket elevator and hoisted 35 feet where they are discharged on a belt conveyor carrying them over the yard tracks. That conveyor, as well as six others, are 4-ply, 28-ounce, rubber-covered belting, 14 inches wide, running in 3-roll troughing idlers with 5-foot centers at a speed of 150 feet per minute. Over 1000 feet of this belting transports the borings from the machine shop to the cupola charging deck where they are screened and delivered into the 150-ton storage bin directly over the feeder hopper on the briquetting machine. Screening is accomplished by a ball bearing, counter flow, single deck screen with ¼ x 1¼-inch rectangular mesh. As the briquets are pushed out of the

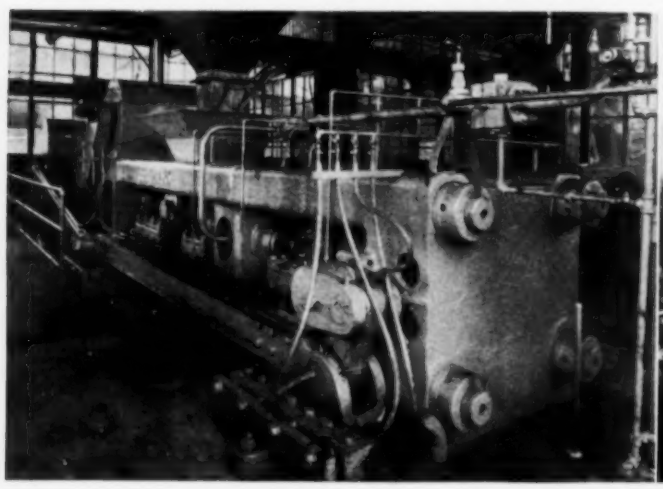


Fig. 1—General View of Machine for Making Briquets. Fig. 2—Deck Storage Line Showing Location of Briquets on the Charge Assembly Line

Table I

No.	Installed	Removed	Briquets Made
1	May 1	May 9	145,717
2	May 9	May 10	23,179
3	May 11	May 21	131,730
4	May 22	May 28	91,781
5	May 29	June 4	40,320
6	June 5	June 7	63,480
7	June 8	June 11	41,688
8	June 11	June 15	75,498
9	June 15	June 24	101,103
10	June 25	July 8	114,918
11	July 8	July 23	165,735
12	July 24	Aug. 14	143,563
13	Aug. 14	Sept. 5	152,305
14	Sept. 5	Oct. 3	146.439
15	Oct. 3	Nov. 25	96,797
16	Nov. 25	Dec. 9	52,897
		Shut Down Total	1,587,150

mold they fall on another short conveyor which conveys them into storage yard underneath the traveling crane. They are then picked up as required by the double magnet crane and placed on the deck ready to be added to the charges for the cupola.

Our machine was installed by the middle of March, 1929 and started in operation with the usual amount of troubles incidental to new equipment of this magnitude. Slight changes in the conveying equipment, the screening arrangement and machine adjustments had to be made. However, during the last half of March and the month of April 202,-287 briquets or 708 net tons were manufactured.

On May 1, 1929 we first started keeping a record of the life of the molds or dies. This record is given in Table I and shows large variations which we found were due to the hardness of the dies, material from which dies were made and to the adjustments of the plungers and cross heads. We found that the best success was obtained from dies made of oil hardening, non-shrink steel as is evidenced in the Table I by dies numbered 9 to 14 inclusive.

At the start of the operations five men were employed; two on the machine and briquet conveyor, and one on the boring conveyor during days and two men nights, which was finally reduced to one man days and one man nights. This reduction was accomplished by speeding up the borings conveyor, and other slight changes, so that it was possible to convey over from the machine shop enough borings in 4 hours to run the machine 20 hours with a production of 75.6 tons of briquets.

The cost of production per net ton of briquets produced for approximately eight months that the machine was in operation during 1929 was as follows:

Labor	$ 3,895.00
Maintenance	3,221.08
Depreciation	4,842.34
Total cost of production	$11,958.42
Net tons produced	6,263

Equals $1.91 per net ton of briquets produced.

We have every reason to believe that the figure of $1.91 per net ton will be reduced in 1930 considerably because of the smaller amount of labor required as previously mentioned, and a marked reduction in the maintenance cost because of more experience and the use of more suitable materials.

The percentages of the various materials used in a charge were as follows:

	Before Per Cent	After Per Cent
No. 2 malleable	34.80	28.40
No. 8 silvery	10.65	10.81
Southern (high phos.)	2.86	2.95
Spiegel	0.13	0.27
Steel rails	18.06	14.26
Cast scrap	32.12	25.36
Rim steel	1.19	0.09
Ferrosilicon	0.08	0.11
Briquets	None	16.67

Those for the first three months of 1929 are given in the first column and the percentages used during the last eight months in the second column. The month of April is left out of the averages intentionally because we were feeling our way along in the use of briquets during this period and it does not represent a fair average.

Table II

	21 March	20 June
Number of days worked		
Average net tons per day	344.74	337.08
No. of bars analyzed		
Drillings from 1-inch bar	357	365
Silicon	2.31	2.35
Sulphur	0.075	0.076
Phosphorus	0.189	0.199
Manganese	0.76	0.73
Total carbon	3.40	3.34
Brinell hardness on 1-inch sq. bar	206	207
Trans. strength 1-inch sq. bar 12-inch centers—pounds	2713.1	2812.5
Defection on 1-inch sq. bar 12-inch centers—inches	0.130	0.136
No. of tensile bars tested	84	80
Tensile strength 0.505-inch bars as case—lbs. per sq. in.	33,850	33,385

From that table it is evident that the amount of purchased material was reduced by 16.67 per cent of the total melt and since the prevailing market price of cast iron borings varies from $10.00 to $14.00 under the market price of pig iron or steel rails in our district, it is easily seen that a large saving in the cost of direct materials used was brought about in our case this saving amounted to $2.16 per net ton of iron charged into the cupola. During the last eight months of 1929 we melted 28,378.28 net tons which multiplied by the $2.16 saving gave us a saving of $61,296.78. Comparing this figure with the cost of the installation, it will be noted that the machine nearly paid for itself in the eight months of operation.

The briquets are loaded into the charging bucket at a station on the regular charging line by hand forking, as shown in Fig. 2. They are placed on the top of the charge to eliminate possible breakage when the charge is dumped into the cupola. Being on top, the coke for

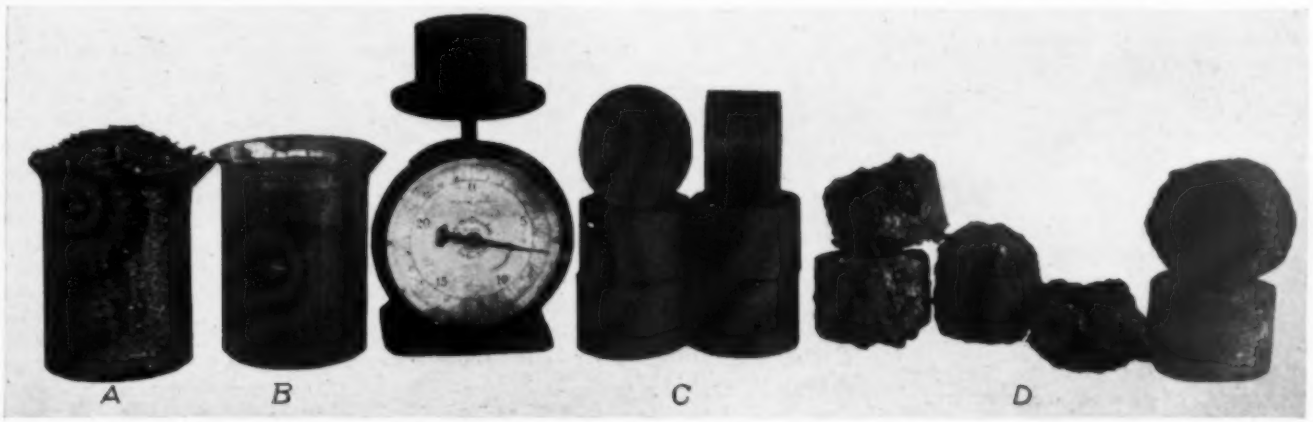


Fig. 3—A Shows Volume of 7 Pounds of Coarse Borings While B shows the Same Weight of Fine Borings. C Is a Group of Briquets Which Average About 7 Pounds Each. D Shows Partially Melted Briquets Found in the Bottom Drop at End of a Regular Heat

the following charge forms a cushion protecting them from the succeeding charge. To take care for the breakage and loose borings, which we have found to amount to a little less than 5 per cent of the borings briquetted, a grating was placed over a spout leading to the ground floor where that material is caught in a dump trailer and returned to the storage hopper for rebriquetting.

Gives Melting Loss

By actual tests on heats made up of all briquets, and by a check on our loss in the cupola through weighing the molten metal as it comes out, we have determined a melting loss of slightly under 10 per cent on the briquetted borings in the cupola. This loss is taken care of by adding 10 per cent to the actual briquetting cost and was considered when figuring the savings made, in a previous paragraph.

We did not find it necessary even when using as high as 21 per cent briquets in the mixture, to use additional flux nor any additional coke in the charge There is no change in the melting rate of the cupola nor in the temperature of the iron at the spout or in the foundry. However, we did find that our oxidation losses of 7 per cent of the total silicon charged into the cupola, increased to 10 per cent. It might be well to remark at this point that the blast pressure in the wind box ranges from 22 to 24 ounces and that a melting rate of 25 to 26 net tons per hour is maintained in a cupola lined to 72 inches inside.

Another point of interest is the fact that the briquets melt similarly to any other cast scrap in the cupola. They do not disintegrate in the melting zone, as is evidenced by the bottom drop on the end of the heat. We have examined a great many briquets that came down with the partially melted charges in the drop. Some idea as to how they fuse and start to melt is pictured in Fig. 3. However, there is a slight display of iron sparks at the charging door during charging operations and more pronounced during the blowing-down operation at the operation at the finish of the heat.

A test heat using all briquetted borings was run on Feb. 28, 1930 in our experimental cupola which is lined to 24 inches. This heat consisted of four charges of 600 pounds each, using 90 pounds coke between charges, 30 pounds limestone and 4 pounds fluorspar. The iron came out hot and a recovery of 2208 pounds was obtained, which gives a melting loss of 8 per cent in the cupola.

The average analysis of the briquets as charged and the average analysis of the metal obtained were as follows:

	Borings in Per Cent	Iron Out Per Cent
Silicon	2.30	1.63
Sulphur	0.08	0.148
Phosphorus	0.195	0.195
Manganese	0.75	0.58
Total carbon	3.35	3.17
Brinell on 1-inch square bar	260	
Transverse on 1-inch square bar	3400	
Deflection on 1-inch square bar	0.13 inch	
Tensile strength	35,660 lbs. per sq. inch	

There was a loss of 26 per cent in the silicon and 21 per cent in the manganese. The physical properties and also the structure were good.

Two factors must be considered when discussing the effect of briquets on metal, first, the quality of the metal, and, second, the quality of the resulting castings. For comparative purposes the months of March and June, 1929 were chosen. Table II gives the average chemical and physical properties on the bars tested for these two months. No briquets were used in March while 16.1 per cent was used in June.

Metal Retains Quality

It is interesting to note in Table II that there is practically no difference in the average chemical and physical properties of the metal during these two months. This can also be said to hold true throughout the length of time we have been using the briquets in the cupola.

Unquestionably, the percentage of good castings produced is the controlling factor paramount in the minds of most foundrymen. A comparison of the distribution of the metal charged into the cupola for the months of March and June which are similar to any other monthly period, follow. These figures are issued monthly by our cost department.

	March Per Cent	June Per Cent
Good castings produced	75.56	75.45
Scrap (foundry defects)	1.54	1.49
Pig bed and overmelt	.70	.73
Loss in melt	1.25	2.47
Indirect metal (gates, sprues, etc.)	20.95	19.86

The item "Loss in Melt," as listed requires some explanation. This item not only represents the melting losses encountered in the cupola itself, but also the amount of metal unaccounted for in the difference between the amount of metal charged into the cupola and the total of the scrap, pig bed, indirect and direct metal accounted for as leaving the foundry. This item averaged 1.97 per cent for the year 1929.

The interesting fact is that there was practically no difference in the percentages of good castings and scrap produced in the month of June when using 16.1 per cent briquets in the mixture as compared to the month of March when no briquets were used.

Another important factor which should be mentioned is the machinability of the castings. Our machine shop could not notice any difference between the machinability of castings with or without borings in the mixture.

In conclusion it is sufficient to say that the question of whether or not briquetted cast iron borings can be used successfully in the cupola resolves itself into a problem of economics. Our experience and that of others using similar equipment proves that there is no detrimental effect on the quality of the metal itself nor on the percentage of good castings produced, when using up to 20 per cent borings in the mixture.

Gage Standards Are Recommended

Thirty-five representatives of manufacturers and users of pressure and vacuum gages and representatives of technical, governmental and safety bodies met recently at New York under the auspices of the American Standards association, 29 West Thirty-ninth street, New York, and recommended the establishment of national standards for that type equipment. A committee was appointed to work on nomenclature and definitions; rules and specifications for installation and use; methods of testing; methods for expressing allowable errors;accuracy requirements; capacity ratings; connections; indicator hands and stop pins; dials and graduations; bearings and attachments; case sizes and mounting holes. The conference favored the development of specifications that would unify the external features of indicating gages and permit a reasonable amount of interchangeability.

Uses Short Time Test

The ordinary fatigue tests of metals and alloys require considerable time for their completion, and from time to time various short time tests have been proposed. These include the short-time, high stress tests; the rise of temperature test developed by Stromeyer and later by Putnam and Harsch; the running deflection test and the power input test. However, most of these tests detect slip rather than the beginning of the fatigue crack. Some time ago Shoji Ikeda developed a method of short time determination of the fatigue limit by electrical resistance, and a slightly modified form of this method was used by Moore and Konzo as described in Bulletin No. 205 of the Engineering experiment station, University of Illinois, Urbana, Ill. The conclusions of the authors are that the Ikeda test shows a fair coincidence of the endurance limit compared with the regular method of testing. In general the Ikeda test gave results on the safe side. The price of the bulletin is 20 cents.

Charles Pack, consulting engineer specializing in die casting practice, has moved his headquarters to 60 East Forty-second street, New York.

BRITISH FOUNDRYMEN *Study* Industry's Technical Problems

By Vincent Delport
European Manager, THE FOUNDRY

SUCCESS crowned the twenty-seventh annual convention of the Institute of British Foundrymen, held at Middlesbrough from June 17 to 20. The city supplied an appropriate setting for the meeting, as it is in the heart of one of the principal iron and steel districts of Great Britain.

The annual general meeting was held at the Constantine Technical college on Wednesday, with Wesley Lambert in the chair. An official address of welcome was given by the mayor of Middlesbrough, Thos. J. Kedward. At the end of his address he presented the Oliver Stubbs medal to J. Ellis, who was president of the institute from 1916 to 1917 and to whom the medal was awarded unanimously "for sterling work done for the institute, and more particularly for his encouragement to the junior section."

The election of officers of the institute for the year 1930-31 followed. F. P. Wilson, Pease & Partners, Ltd., Middlesbrough, was elected president. In taking over his duties, Mr. Wilson mentioned that Middlesbrough is the youngest branch of the Institute of British Foundrymen, and already it has assumed considerable importance. A vote of thanks then was proposed to Mr. Lambert for the splendid manner in which he had assumed the responsibility of chairmanship during the past year, more especially in connection with the international foundry congress which was held in London in June, 1929. In replying to the vote of thanks, Mr. Lambert expressed his satisfaction at the success of this big convention, a success which was mainly due to the close co-operation of the staff of the institute. He also referred to the decision taken during the course of the year to form a technical committee which would be permanently in charge of the study of various questions of a technical nature pertaining to the foundry industry.

A. Harley, foundry manager, Daimler Co., Ltd., Coventry, was elected senior vice president. V. Stobie, steel founder, of Oakfield, Ryton-on-Tyne, was elected junior vice president. It then was announced that F. W. Finch, honorary treasurer of the institute, had asked to be relieved of his post after many years of faithful service. It was unanimously decided that W. B. Lake, of Lake & Elliot, Ltd., Braintree, should take his place.

Diplomas for the best papers presented during the year at the various branch meetings were awarded to C. H. Kain, Lake & Elliot, Ltd., Mr. Bartly, S. Southcott, member of the Wales and Monmouth branch, and J. Service, member of the Lancashire branch. The Buchanan medal for junior members was awarded to A. Sutcliffe, member of the Lancashire branch, and Mr. Hubbal, of the Birmingham branch.

In his presidential address, Mr. Wilson referred to the first convention held in Middlesbrough, in 1906, on the occasion of the third meeting of the institute, when only 169 members were on the roll. As far back as 1906 such subjects as shrinking and the grade of cast iron by fracture were discussed. From the 169 members in 1906, the membership roll now has reached 1800. Mr. Wilson pointed out the danger of papers becoming too technical, and said that the commercial side of the foundry trade should not be overlooked, and that particularly the question of cost is of outstanding importance, more especially with regard to standard methods of costing.

He also suggested that steps should be taken to establish a national certificate to be given by the Institute of British Foundrymen to students. The certificate will be delivered following an examination. With regard to old members, the certificate could be delivered provided that the member had been closely associated with the foundry trade for a given period of years.

Referring to the membership of the institute, Mr. Wilson mentioned that there are about 5000 foundries in Great Britain, and that it should be possible to increase the membership among firms and workers. He referred to the large number of special committees that have been established by the American Foundrymen's association, and suggested that it would be advisable for a certain number of additional committees to be formed by the Institute of British Foundrymen.

The first step in this direction has been taken with regard to the technical committee, mentioned by Mr. Lambert. Mr. Wilson stated that, according to J. G. Pearce, director of the British Cast Iron Research association, the annual value of iron castings, without finishing costs, in Great Britain attained $200,000,000. Mr. Wilson expressed the appreciation of the institute for the assistance given by the British Cast Iron Research association to the foundry industry.

In conclusion the president pointed out the good influence exerted by the Institute of British Foundrymen, inasmuch as it can be considered as a

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welfare agency which brings together workers and employers, and in connection with the annual conventions, the foundry associations are a considerable factor in cementing friendships between nations.

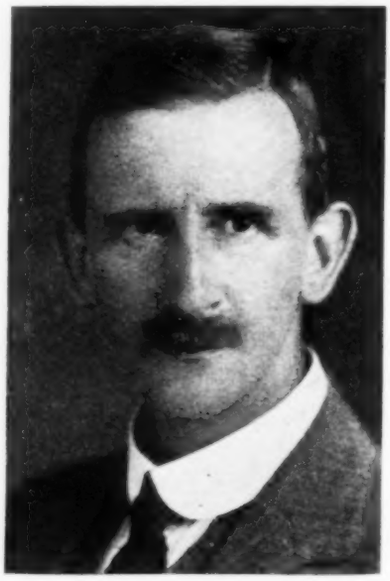
The first paper presented Wednesday morning was by C. H. and N. D. Ridsdale, Middlesborough, on "The Economic Utilization of British Pig Iron Resources." This paper is of considerable interest to the foundrymen of Great Britain as it gives information that will enable a foundryman to select varied brands of iron for his own particular purpose, but at the same time using iron produced as near his own locality as possible. The paper gave rise to a lengthy discussion, dealing with the particular conditions pertaining to the production of pig iron in England and Scotland. Several points of general interest also were raised.

J. E. Fletcher, British Cast Iron Research association, said that the problem of using all-ore pig iron as against mixing steel in the charge is an important one, and there are certain dangers to be avoided. Many people prefer an all-ore iron which has an analysis nearest to the one required rather than a mixture of pig iron and steel.

F. J. Cook, of Birmingham, said he believes that some old fashioned irons have certain qualities which are not disclosed by analyses and which are not found in present-day mixtures. Referring to the authors' mention of the addition of punchings to the charge, Mr. Cook recommended that punchings should not be used due to the small size. He emphasized the fact that the analysis given in the paper are not to be taken as absolute figures, but as averages. Reference was made to the authors' mention of hard spots occurring when steel is mixed with the charge, and it was stated in the discussion that when the cupola is properly adjusted, these hard spots do not occur. Emphasis also was laid on the difference between the use of high manganese pig iron as an addition, and an addition in the form of ferromanganese.

At the end of the morning session the American exchange paper, "Briquetting Cast Iron Borings," by Fred J. Walls, Wilson Foundry and Machine Co., Pontiac, Mich., was read by Vincent Delport. The paper was listened to with considerable interest, and the appreciation of the members was expressed for this contribution from the American Foundrymen's association. During the same morning a paper was presented at another session by F. W. Roe, Lancashire, branch, on Founding of Bronze Gear Blanks."

On Thursday, June 19, two technical sessions were held. In the main hall the exchange paper of the Association Technique de Fonderie de Paris was presented, the title being: "Methods of Molding Castings for Stoves, Heating Apparatus and Various Builders' Castings," by H. Magdelenat, vice-president of the French association. Another paper, by W. Scott, Dunston-on-Tyne, dealt with "The Production of Large and Medium-Sized High-Class Iron Castings." The discussion which followed the presentation of these two papers brought out many individual experiences. The necessity of using standard colors for patterns was referred to, and F. J. Cook mentioned that the British Engineering Standards association is studying this question, with the assistance of two representatives of the Institute of British Foundrymen, and that, no



F. D. WILSON

doubt, standard colors eventually would be adopted.

Frank Hudson, Fordath Engineering Co., Ltd., West Bromwich, contributed a paper on "The Reclamation of Oil-Sand Cores." A. Sutcliffe opening the discussion and referring to the use of ladles lined with ganister pointed out that the lining grows in time to a point where it overlaps the edges of the ladle. He asked how this could be overcome. In reply, Mr. Hudson said that this growth hardly can be avoided that it reaches a maximum point, and then grows no more. A speaker mentioned that a ladle which is always kept at a good heat before tapping will not grow so much as when it has been allowed to grow cold. A. R. Bartlett said that he does not believe that the cost of reclamation of oil-sand is justified, and that the use of reclaimed sand can be detrimental. Mr. Hudson stated that it could only be detrimental in certain cases, and he pointed out that if one uses old oil-sands which have not been reclaimed, the economy is not what one thinks it is because more binder has to be used.

J. W. Gardom, Dunstable, said that in the last analysis the question came down to the first cost of sands. The cost involved by the use of core sand is quite small in relation to the general costs, and the economy realized by oil-sand reclamation is only of practical interest when it applies to super-efficient foundries. It must not be forgotten that the reclamation process requires attendance for the mechanical equipment, and this has to be paid for.

Referring to the heating of the sand, the speaker stated that too much heating splits the silica grains. Mr. Hudson, replying, said that oil-sand cores will be more and more used in the foundry, and that, consequently, the problem eventually will gain in interest. The problem of economy will increase in interest as time goes on. Referring to the washing of the new sand, he stated that there is a film of oil which cannot be taken away by water, and that attempts to extract the water from the sand, which have been made in America, have proved unsuccessful. At the end of the session, Dr. Douglas H. Ingall, Constantine Technical college, Middlesbrough, presented a paper entitled: "The Factor of Personnel with Regard to the Future of British Foundry Practice."

In another hall a session was devoted to steel foundry questions. Three papers were presented: the exchange paper of the Association Technique de Fonderie de Belgique, dealing with "The Preparation of the Metal for Converter Steel Castings," by J. Leonard, president of the Belgian association. This was followed by a paper by J. Deschamps, Kryn & Lahy (1928), Ltd., entitled "The Future of the Side-Blown Converter in the Steel Foundry." The third paper, by T. W. Barley, dealt with "The Economic Utilization of Compressed Air in Steel Foundry Practice." A joint discussion followed the presentation of these three papers.

Opening the discussion on Mr. Leonard's paper, J. Deschamps said that the author made mention of the use of all pig iron charges. Mr. Deschamps stated that, according to modern practice, large percentages of scrap are employed, and up to 100 per cent scrap is being used successfully.

V. Stobie said that the fluidity of converter steel is due mainly to the presence of oxide of iron,, and he wondered how Mr. Deschamps obtains the required fluidity if he gets rid of the oxide. W. Shaw, of Middlesbrough said that in open-hearth practice you do not get excessive fluidity, and you get sound castings. Mr. Deschamps replied that the question of fluidity versus oxidation is a controversial one. Even assuming that fluidity is due to the presence of oxide, the actual problem can only be checked by the examination of test pieces which are cast on the casting. In view of his results, Mr. Deschamps said that it is immaterial whether there are oxides in the steel or not.

Replying to certain remarks made about the air compressor plants used in the steel foundry, Mr. Barley, the

(*Continued on Page* 81)

Questions & Answers on FOUNDRY PRACTICE

GENERAL

Patterns Are Finished

QUESTION

I shall appreciate greatly the latest information on aluminum patterns. What is the best mixture for the purpose? How are the patterns finished? At present we finish our aluminum patterns by filing, scraping and sanding. This method is so slow that I am wondering if we are behind the times. Surely some method has been developed that is faster than the one we now are using.

ANSWER

Filing, sanding and scraping are the accepted methods of finishing aluminum patterns with the exception of those that may be finished in a lathe, planer or milling machine. Pattern-making in any material essentially is a slow process in which a great deal of the work must be done by hand. Some part of the work may be entrusted to men who have little skill or training, but by far the greater part only may be entrusted to men who have had long experience. Your present practice probably compares favorably with that elsewhere.

Character of the aluminum mixture will depend to a considerable extent on the size and shape of the required pattern. Satisfactory patterns have been made from an all scrap mixture. In other instances where a high tensile strength is the most essential feature the mixture may contain zinc in varying proportions from 10 to 35 per cent. The usual metal employed is the familiar No. 12 alloy containing aluminum 92 per cent and copper 8 per cent. Two typical alloys for aluminum patterns follow: 1—Pure aluminum, 79 pounds; aluminum hardener, 4 pounds; tin, 2 pounds; zinc, 15 pounds. 2—Pure aluminum, 80 pounds; aluminum hardener, 10 pounds; tin 10 pounds. The hardener is prepared by melting equal parts of copper and aluminum. For comprehensive information on the subject of aluminum and its alloys see "Aluminum and its Alloys" by Corson; "The Metallurgy of Aluminum and Aluminum Alloys" by R. G. Anderson, "Metals and Their Alloys" by Charles Vickers and "The Aluminum Industry" by Edwards. Frary and Jefferies.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions should be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Shows Average Loss

QUESTION

What is the average castings loss in gray iron foundries engaged in the production of machinery castings.

ANSWER

Your question might be interpreted in two ways and the answer naturally would vary with the interpretation. As with many other features in connection with the cupola, two methods are employed in figuring the loss. In the first the weight of good castings is compared with the total weight of iron charged in the cupola. In the second method the actual weight of the scrap castings is compared with the weight of good castings and a percentage reckoned on that basis. Naturally a wide discrepancy will be noted between answers taken from positions so different in basis of consideration.

For bookkeeping purposes the first method is quite satisfactory since the defective castings, gates, miscellaneous scrap, over iron and melting loss are covered under one head. This was the method adopted by the American Foundrymen's association a few years ago when a questionnaire was sent to a selected list of foundries to determine the average loss. Replies were tabulated and grouped under ten headings: General jobbing, light jobbing, light machinery, heavy machinery, stoveplate, sanitary ware, agricultural railroad, floor plates and grate bars, car wheels.

Results were shown under the headings: Per cent melt in castings, per cent in returns, and per cent melt lost. In the general jobbing column these items were shown respectively as: 83.9, 8.2 and 7.7 per cent. In other words the average general jobbing shop secured a yield of 83.9 per cent good castings, basing the percentage on the amount of metal charged in the cupola.

Where the calculation is based on a comparison of the actual weight of scrap castings and good castings, experience seems to show that under proper conditions the loss should not exceed 5 per cent over a period of a year.

Q & A

Uses Electric Furnace

QUESTION

How many foundries in the United States employ a duplexing process with a cupola and electric furnace for making gray iron castings. Are small quantities of metal, say 200 pounds, handled in this manner. Is the hot blast a common feature in American cupolas and what are its advantages. Are piston rings cast in permanent molds in the United States.

ANSWER

This reply to your inquiry is numbered to correspond with the order in which the questions are presented.

1.—So far as we know the Ford foundry in Detroit is the only place in the United States where a duplex-

ing process for gray iron involving the electric furnace and the cupola, is employed regularly and consistently. A description of the process at this plant appeared in THE FOUNDRY, Sept. 15, 1927, page 210. A duplexing process is employed by one company and a triplexing process is used by another in melting and superheating malleable iron. In other foundries operating electric furnaces on gray iron castings, the metal is charged cold and is melted, refined and superheated in the one furnace. The electric furnace has entered the gray iron foundry to a considerable extent in recent years and we suggest you write direct to the manufacturers for the most recent developments. Names and addresses may be found in the advertising pages of THE FOUNDRY.

2.—We know of no foundry in this country where small quantities of iron, 200 pounds, are duplexed. If your problem revolves around the successful treatment of small quantities of iron you will be interested in the smallest size of electric furnace.

3.—Up to the present only a relatively few foundries in this country have applied a recuperating device for preheating the blast before it enters the cupola. A considerable reduction in the amount of coke required between the charges has been reported, but none have reported superheated condition of the iron. The recuperating process only has been applied in foundries where exceedingly high temperature is not necessary. As opposed to this, temperatures up to approximately 2900 degrees Fahr. are obtained with a cold blast in all production foundries and specialty shops where exceedingly hot iron is a prime requisite. An account of Piwowarski's experiments in superheating gray iron in Germany was published in THE FOUNDRY in two parts April 1 and April 15, 1927.

4.—Several attempts have been made at various times in American foundries to cast piston rings in permanent molds, either stationary molds in which dry sand cores formed the inside, or, in rapidly whirling molds where the metal assumed the required shape of the casting by centrifugal force. Work of a similar character also has been carried on in England.

Q & A

Hard Core Is Cause

QUESTION

We are sending you for examination a casting which has given us considerable trouble. We have molded it in practically every position on its side, flange side up and flange side down and still the trouble persists. We have poured it with and without risers, with and without chills without securing a perfect casting. We shall appreciate your opinion on the subject.

ANSWER

This small gray iron casting 7½ inches diameter with a hub 4¼ inches diameter, bored out to 3 inches for the depth of the hub and ¾-inch through the flange seems to present no difficulty if ordinary precautions are observed while molding it. Since you have experienced trouble irrespective of the position in which it was molded then the cause of the trouble must lie elsewhere. From an examination of the casting submitted which shows defects on the inside at the junction of the hub with the flange we are inclined to the opinion that the center core is the cause of all the trouble. The gas does not escape readily from this core, especially from the shoulder that is covered with molten metal on the side and on the top. This gas sets up a commotion and the defective area in the casting is the result.

To test out this theory, make several special cores and place them in marked molds so that you may be in a position to check results when the castings are machined. Take exaggerated precautions with the first set of cores so that no doubt will remain in your mind in the event that this diagnosis is mistaken. For example, cut down on the binder, dry the cores almost to the point of burning and vent the core with a wire before you remove it from the corebox. Take a brass sprue cutter and cut a large vent hole in the center. Vent the print in the mold before the core is placed and see that a proper channel is provided for the gas to escape, either through a hole in the bottom board or through a channel between the bottom board and the lower edge of the drag.

GRAY IRON

Shrinks Cause Trouble

QUESTION

I am sending two defective wheel castings which are giving me much trouble due to shrinks in the hubs. These castings are gated at the rim, but I have tried putting a riser on the hub without success. I am using a 3000-pound charge composed of 1800 pounds of southern pig iron; 900 pounds of return scrap; 300 pounds of light machine scrap. The bed in the cupola is 36 inches above the tuyeres and 250 pounds of coke is used between charges. Changes in pouring temperature and methods of gating the castings seem to have no effect.

ANSWER

One of the wheel blanks sent is 5½ inches in diameter with a solid web connecting the hub and rim. It was cast with a riser over the hub, and shows a bad shrink where the riser joins the hub. The other specimen sent is only the hub section of a slightly different wheel and also shows a shrink. While you do not give any information on the depth of the cope flask, our examination leads us to believe that the shrinks are caused by a low head of metal. Another contributing cause is cold metal. Therefore we suggest that you increase the height of the metal head by using either a deeper cope flask, or employing some kind of a runner box that will increase the height of the gate 4 or 5 inches. This box may be formed in green sand or may be a hollow core of the proper dimensions.

To obtain good hot iron from your cupola, you will have to increase your charge of coke to 375 pounds. At present you have an iron to coke ratio of approximately 12 to 1 which is entirely too high. Increasing your coke to 375 pounds per charge will give a ratio of 8 to 1 which is nearer usual practice. It maybe that you will have better success by reducing the weight of your iron charges to 2000 pounds with coke splits ranging from 200 to 250 pounds.

Q & A

Iron Is Oxidized

QUESTION

We are sending you a sample of iron melted in our cupola which appears to be badly gassed. The iron contained 2.75 per cent silicon, 0.122 per cent sulphur, 0.57 per cent phosphorus and 0.49 per cent manganese. Loss from the trouble increased to 25 per cent. Our charges consist of 700 pounds of sprues and gangway scrap and 1300 pounds of pig iron. The cupola is lined to 46 inches with a single row of tuyeres. Wood is used for lighting the bed which is 34 inches above the tuyeres after the bed has burned through. The melting zone appears to be 26 inches above the tuyeres.

ANSWER

The specimen sent to us is a piece of a casting shaped like an angle iron with two unequal legs. One leg is 1⅛ inches long and ⅜-inch thick and the other leg is ⅝-inch long and ½-inch thick. The best description of the fractured surface is that it looks like a piece of swiss cheese. The holes have bright interiors and appear to extend from the center of the piece to the outside, but do not go through the skin. After considering several theories as to the possible cause of the holes, we have concluded that it is due to oxidized iron. This condition may be caused by a poor lot of pig iron or it may be caused by poor cupola operation.

If it is caused by the pig iron, you will have to run down the iron causing the trouble by cut and try. That is to say, leave out one car of iron for several days and see what effect it has. Do this with the various cars until the trouble ceases and then use only small amounts of that particular car in each charge. However, we believe that your cupola practice may be checked up to advantage, particularly if it is true that the melting zone is 26 inches above the tuyeres. Usually the bottom of the melting zone is not more than 24 inches above the top of the tuyeres, and not over 20 inches wide in extreme cases. If the figures for your cupola vary much from those given, you are using to much blast

(*Continued on Page* 77)

The FOUNDRY Family Photograph Album

Upper Left

O. W. ELLIS

Ontario Research Foundation, Toronto, Ont.

Upper Right

E. LANCASHIRE

American Steel Foundries, Alliance, O.

Lower Left

R. S. MACPHERRAN

Allis-Chalmers Mfg. Co., Milwaukee

Lower Right

F. D. CHASE

Frank D. Chase Inc., Chicago

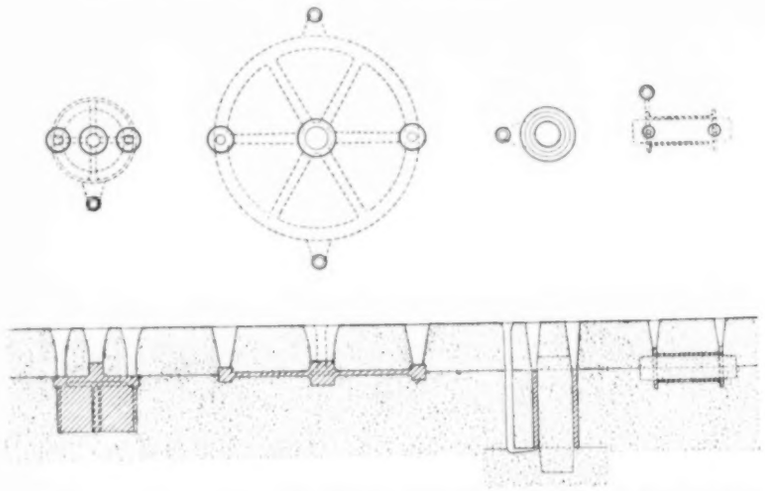
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

MONEL METAL AND NICKEL FOUNDRY PRACTICE

(*Continued from Data Sheet No.* 820)

heavy sections properly. As monel metal and nickel chill rapidly, the risers should be large enough to feed the casting properly.

Castings made from patterns having sharp changes in section are subject to considerable trouble from shrinkage and pulling. A chill placed at the heavy section so as to bring its cooling rate to approximately that of the thin section is often beneficial. Large fillets are recommended at all corners. Molds for typical castings should be provided with gates and risers arranged as shown in the accompanying illustration.



ARRANGEMENT OF GATES AND RISERS NECESSARY FOR THE PRODUCTION OF MONEL METAL AND NICKEL CASTINGS

It is advisable to use a minimum amount of binder in the sand, because both monel metal and nickel are sensitive to the gases generated by such binders. An open sand that is highly refractory is necessary, and the molds should be well vented to allow the easy escape of the gases.

For light castings weighing up to 4 pounds, of both monel metal and nickel, a mixture of one part of No. 1 Albany sand, one part of Jersey sand and three parts of old (black) sand is used. This is mixed with either plain water or clay water until the sand is moist enough to stick together when squeezed in the hand. Medium sized castings weighing from 5 to 20 pounds are molded in a sand consisting of two parts of old (black) sand

(*Continued on Data Sheet No.* 822)

MONEL METAL AND NICKEL FOUNDRY PRACTICE

(*Continued from Data Sheet No.* 821)

and one part of new No. 1 Albany. The sand for heavy castings consists of a mixture of one wheelbarrowful each of Millville gravel, old (black) sand and Lumberton sand, and one shovelful of flour. Water or clay water is added, as for light castings.

Molds for medium weight and heavy castings are well dried before metal is poured into them. Before they are put into the drying oven, they are sprayed with a mixture consisting of equal parts of water and linseed oil and are then coated with a mixture of equal parts of black lead and clay. Light castings may be poured into green-sand molds.

Cores are made of a good grade of silica sand to which pure raw linseed oil is added as a binder. The ordinary proprietary core oils sold under various trade names are unsatisfactory because the large quantity of gas evolved is decidedly harmful to both monel metal and nickel.

The high shrinkage of these metals necessitates the use of soft cores, but these cores must not be so soft that they will crumble or burn when the metal strikes them. Large cores should be hollowed out and filled with cinders or coke, to allow them to collapse easily.

Monel metal and nickel can be melted, with good results, in various types of furnaces. Castings are made successfully of metal melted in crucible, open-hearth, single-phase or three-phase electric furnaces. The metal supplied for casting purposes is either in the form of small ingots weighing 5 or 20 pounds or in the form of shot, depending on the requirements of the customer. This material is melted down and just before it is ready to pour the necessary silicon is added. If ingot blocks are used, approximately 1½ pounds of metallic silicon should be added for each 100 pounds of metal. This applies to the majority of castings. If the castings are made by melting shot about ½ pound of silicon per 100 pounds of metal should be added, as the shot contains initially about 1 per cent silicon.

The silicon is added about five minutes before pouring and is well stirred in with a wooden pole. Just before pouring 1½ ounces magnesium per 100 pounds of metal is added. This is used because of its effective desulphurizing and deoxidizing qualities. Stick magnesium only should be used. It is introduced by plunging it well under the surface of the metal with iron tongs, and is then stirred for a few seconds to allow it to diffuse throughout the metal. If the magnesium burns on the surface, no good is derived from it and an additional amount should be added. After the addition of magnesium, the metal is ready to be poured. Pouring should be done as quickly as possible but not so quickly as to prevent the escape of the gases.

Unless electric furnaces are used, low-sulphur fuel oil, containing not

(*Continued on Data Sheet No.* 823)

(*Continued from Page* 74)

We believe that you may lower your bed 30 inches above the tuyeres. However, you can check up on this easily by observing the appearance of the molten iron. See that it melts good and hot. To determine the proper blast volume, you will have to determine how much coke is burned per minute in the cupola. This can be calculated from the number of charges melted per hour. You should supply about 132 cubic feet of air for every pound of coke burned. For example, a cupola 46 inches inside the lining will melt about 9 tons per hour. If 210 pounds of coke is used between each charge, the total coke consumption will be 2250 pounds per hour or 37.5 pounds per minute. Using these figures 4950 cubic feet of air per minute should be supplied. This is a theoretical value and may have to be lowered or increased to meet your own particular needs.

Q & A

Small Holes Interfere

QUESTION

Recently our castings have been developing small holes during the enameling process and we are at a loss to determine the cause or to provide preventative measures.

ANSWER

Small pin holes that only make their appearance on the face of the casting during the enameling process may be due to either the melting or the molding practice. If through a low bed or a high blast or both, the iron in the cupola is subjected to a bessemerizing action, it will carry some of the gas into the mold in occluded form. Most of the gas will work its way out of the metal, but enough will remain, particularly in thin castings to cause the pin holes. In the majority of cases pin holes are caused by steam from the sand. Under ordinary conditions and with a suitable grade of sand, all the steam escapes readily through the natural passages. Where the sand is rammed too hard, where too much water is employed, or where the permeability of the sand is impaired by dust or excess bond, all the steam cannot escape readily in a direction away from the casting. Some of the steam becomes entrapped and forms the pin holes. Examine the melting, molding practice and materials and if any changes have been made in either or both lately, have them adjusted.

Q & A

Carbon Is Too High

QUESTION

We have been in the habit of sending our iron to an outside chemist to be analyzed and the last iron showed the following results according to the chemist. Total carbon, 3.28 per cent; graphitic carbon, 3.13 per cent; silicon, 2.77 per cent; sulphur, 0.078 per cent; phosphorus, 0.65 and manganese, 0.504 per cent. I would like to know why this iron is so high in carbon. The iron is quite soft, but according to the analysis it should be hard as it contains 1.15 per cent combined carbon by difference. We are melting about 13 tons of iron in a 54-inch cupola with a melting rate of 10½ tons per hour. The coke ratio is 1 to 7.4, and the iron is used for enameling purposes.

ANSWER

In a cupola operating as you indicate, it is hardly possible to obtain an analysis so high in carbon, and with the combined carbon shown, the castings would be quite hard. With an iron containing 2.77 per cent silicon, a total carbon of 3.28 per cent; graphite, 3.13 per cent and combined carbon, 0.15 per cent commonly is obtained. A combined carbon of 0.15 per cent would not be unusual if the sample analyzed were obtained from a test bar or other casting over ½-inch thick cooled slowly. We suggest that you have your analysis checked by a consulting and testing laboratory.

Q & A

Radiators Are Defective

QUESTION

We are sending two defective radiator castings which show shrink holes at the hubs. In the larger piece the hole appears on the cope side at the gate end, and in the smaller the hole is at the opposite end on the drag side. This difficulty causes high losses at times, appearing for a few days and then disappearing without any changes in practice. Our analysis on the day the defective castings appeared was 2.18 per cent silicon; 0.082 per cent phosphorus, and 0.58 per cent manganese. These shrinks appear mostly in 22-inch-5 column and 20-inch-5 column radiators. Other sizes gated, poured, etc. in the same manner are affected rarely.

ANSWER

Careful examination of the specimens sent indicate that the difficulty is not due to shrinkage but from the method of molding. This conclusion also is confirmed by the fact that the trouble is confined to only two types of castings and because of its cycle of appearing and disappearing. Experience in radiator manufacture has shown that too much care in ramming, peening and tucking cannot be exerted if the best results are to be obtained. If the molder is careless in ramming and strikes the sand over the hub section a little too hard, defects of the type mentioned will appear. The actual cause is that the mold gases, instead of passing out through the sand, strike back into the liquid or partly liquid metal. It may be due not only to hard ramming but to the sand condition. If the sand packs easily or is a little too moist, slight variations in ramming will pack the sand too closely. Another operation to be watched carefully is peening the sand around the outside edges of the flask. We suggest that you watch the molding carefully; instructing the molder to avoid ramming over the hub, or at most ramming lightly, and be careful with the peener.

Q & A

Ages Iron Artificially

QUESTION

Will you kindly advise us if there is an artificial method for ageing gray iron castings?

ANSWER

In days past, ageing was accomplished by long time exposure of the castings to the atmosphere, and was more effective if a rough machining cut was taken before the exposure. The modern method is to age the castings at elevated temperatures. If the object is to relieve stresses and minimize warpage with no impairment to the physical properties of the castings, the ageing must be carried on well under the critical range. A temperature from 800 to 900 degrees Fahr. will be sufficient, and the castings should be held at full temperature for at least 1 hour for every inch of section thickness—with preferably 2 hours per inch.

In all treatments at elevated temperatures, the castings should be brought up to temperature slowly and cooled slowly. They also should be supported properly. If softening and lowering of the strength of the castings is not objectionable, higher temperatures may be used. At 1400 degrees Fahr. only a short time is necessary to complete softening and ageing. However, this practice is not recommended for heavy duty castings.

MALLEABLE

Sets Manganese Limit

QUESTION

What would you consider to be the maximum figure that manganese should reach in the hard iron state which would not be detrimental to good, commercial malleable cast iron? Also, what in your opinion, is the effect that a change in this element would have on the finished malleable casting, and can that effect be controlled in the annealing?

ANSWER

It is usually considered that manganese should be 1.7 times the sulphur plus an additional amount of about 0.10 to 0.15 per cent. A practically equivalent statement is that for ordinary values of sulphur the manganese should be three times the sulphur. If the manganese exceeds these amounts considerably, then annealing is retarded to a degree depending on the excess of manganese. Longer annealing will overcome this difficulty but too large an excess of manganese will entail prohibitive annealing times. The effect of the excess of manganese on physical properties is indirect being principally the effect of the remaining combined carbon which persists because of incomplete anneal.

Problems in Nonferrous Founding

By Charles Vickers

Makes Plating Anodes

We are users of brass anodes for general brass plating work and are desirous of making our own anodes. We would appreciate a formula for such work.

Brass anodes are made of an alloy of 2 parts of copper to 1 part of zinc. In percentages the formula is 66 parts copper and 34 parts of zinc. It is best to use nothing but new metals, as lead is an injurious impurity in such a casting. A bronze anode is made of copper 90 per cent and zinc, 10 per cent. It also should be made of new metals.

Q & A

Wants Bell Mixtures

Would you kindly give us a mixture for brass church bells, of which we make a number. These bells weigh from 1000 to 4000 pounds each. We have been using scrap brass mixtures for these, say 50 per cent scrap, 40 per cent copper and 10 per cent tin. The scrap consists mainly of car journals.

The composition 80 per cent copper, 20 per cent tin is an average bell metal, and if all new metal had been used, the tone of the bells would have been satisfactory. However, the scrap car brasses will spoil the mixture because the composition of car brasses is uncertain. They may be simply yellow brass, or anything else, but above all they all carry as much lead as can be added and stay in solid solution. Lead is the worst possible addition that can be made to a bell metal, as it deadens the tone of the bell.

According to Sperry there are three principal bell metal mixtures, the three and one mixture; the four and one mixture, and the five and one mixture. The three and one mixture contains 75 per cent copper and 25 per cent tin, and it is used for the largest bells. The four and one mixture contains 80 per cent copper and 20 per cent tin, and it is a good mixture for any kind of a bell. Variations of these mixtures are common. For example 78 per cent copper and 22 per cent tin is a mixture frequently used for church bells. The five and one mixture contains 83.33 per cent copper and 16.67 per cent tin, and it is suitable for the smaller bells.

Phosphorus, zinc and lead are all injurious to the tone of a bell and should be omitted from the mixture. As a deoxidizer of a bell metal consisting, as it should of copper and tin only, silicon copper is valuable. Add about 4 ounces of 10 per cent silicon-copper per hundred pounds of bell metal, or 0.25 per cent.

Q & A

Surface Becomes Pitted

We are making some yellow brass castings requiring a fine surface. These are made in green sand faced with a mixture of Windsor Locks, French sand and molasses and skin dried. The surface is coming pitted. Can you tell us the reason for this and suggest a remedy?

We do not understand what is meant by the word *pitted*, unless it means porosity. The small pores often found in brasswork after it is machined are nothing else but pits in the metal surface, and they may be caused by hard cores, and too hard sand surfaces. Many defects can be caused by injudicious ramming of the mold, or a little too much water in the sand.

Roughness of the surface may be caused by using facing sand that is a little too damp, and then rubbing it through the seive with the hand, instead of riddling it on to the face of the pattern. In such case the sand is extruded like little worms, which fail to thoroughly amalgamate when rammed. There are tiny spaces left into which the metal flows and produces the roughness. It is advisable to mix all facing sand the night before it is to be used, thus giving time for it to mellow. From the combination of sands used for facing these molds, one would imagine the castings would appear with surfaces as smooth as though polished and buffed, but evidently there is a slip somewhere. We prefer a facing made from No. 00 Albany sand, and if we could print it back with beam dust, or some equivalent to beam dust, we would have a surface that would be hard to imitate in any sand.

To remedy this pitted surface condition we suggest the molds be skin dried more completely than at present, keeping in mind the fact that skin drying has to be done immediately before the molds are poured. They must not stand waiting for the metal. They have to be poured while the dried faces of the mold are hot, otherwise the moisture will strike back and the result will be worse than if poured in green sand.

Q & A

Makes Brass Flux

Has it been the experience of your readers to use plaster of paris as a flux in melting red brass, of the 85-5-5-5 type? This has been recommended to us, but before using it we would like to know the experience of others.

As a flux plaster of paris has been extensively used but we know of no particular virtues that it possesses over other and more rational fluxes. To be efficient it cannot be used alone, but must be mixed with other substances such as soda ash, fluorspar, etc. Otherwise it will gather into lumps instead of melting to a liquid slag.

What is wanted in melting brass is some inert substance that will melt easily and make a liquid slag that will spread over the surface of the metal. Glass is the thing that will do this to perfection, but ground glass is double the price of plaster of paris. So most foundrymen make their own flux, as follows: Sharp sand 63 per cent; soda ash 25 per cent; slaked lime 12 per cent.

We suggest that you use that mixture as a flux instead of plaster of paris, in noncrucible, oil or gas-fired furnaces and use an oxidizing and not a reducing flame. This, of course means to use discretion. While the flame is oxidizing it should not be carried to extremes, using unnecessary air on uncovered metal. At no stage of the emptying of such a furnace can chances be taken by playing the flame on the bare metal.

For crucible furnaces using oil or gas the best flux is a small amount of borax in the bottom of the crucibles when charged cold. A 200-pound pot of brass ought to be ready to pour in a trifle over half an hour with a hot furnace. Starting cold, the heat should be out within an hour. Then it becomes a question whether or not, a molten flux is more harmful than good, so it is best to leave it off. On the other hand prolonged melting requires a flux or covering over the metal. We have to be guided by the circumstances under which the melting is done. A flux must always come to the liquid form in brass melting.

Bill Tells of Molding a Smoke Stack-I

By Pat Dwyer

JUST suppose" Bill said the other night, "just suppose for the sake of argument, that you were free to do as you please, no entangling alliances and so forth, where would you like to spend a vacation?"

"Is that an invitation?" I asked him "or is it just another silly question prompted by idle curiosity?"

"What's the difference?" Bill inquired. "However, if it will set your mind at rest and enable you to concentrate sufficiently to answer a plain and simple question, I have no intention of asking you to join me on my private yacht or to make one of the merry party at my palatial summer home in the north country. With this point settled, satisfactorily I trust to all parties concerned, perhaps you will see your way clear to answering a civil question."

"If I thought there was the slightest chance of you doing such a thing" I said, "I would ask you to consult a noble work of reference, the late Mr. Webster's dictionary, no more, no less. Therein, to your surprise, no doubt, you would find a nice shade of difference—two or three shades in fact—between a civil question and one which Mr. Webster with his well known astuteness characterizes as just plain nosey."

"How would you like," Bill inquired rudely, "to take your old friend Webster, or web feet, or whatever his name is, in one hand, grab his perishin' old book in the other hand and take a long running jump in the lake, hey? Just between ourselves now, between man and beast as you might say, how does that sportin' proposition strike you?"

"Make it a cosy little foursome," I said "you and I, Noah and the book, and I shall be happy to join you."

"Noah? Where does this here Noah guy come in?"

"In the front row, my lad. He wrote the book."

"What book?"

"The dictionary. What book do you think I am talking about, *Uncle Tom's Cabin?*"

"A fat lot you know about it," Bill commented pityingly "why, everybody—well, with possibly one exception—everybody over the age of three, knows that Noah was the guy who built the Ark! The only books in Noah's time were a few hunks of rock with Kosher signs carved on them with a hammer and chisel. Noah was a shipbuilder with the usual sea faring man's aversion to water as a beverage, but I never have seen any reference to his skill as a stone cutter."

"Well," I admitted "strictly among ourselves and with the understanding that this goes no farther, I never have placed full credence in the Ark story. However, now that I have convinced you that Noah had nothing to do with the dictionary, perhaps you will come back to the original point and tell me where you would like to spend a vacation."

"Since you know so much," I said "about Noah, his ark and his family, I suppose you will be telling me next, that Joan of Arc was one of the old boy's daughters-in-law."

"Joan O'Vark? Say, young fella, take another look in that dictionary of yours. You're getting two families mixed. Joan O'Vark was a sprightly young Irish colleen with a patriotic aversion to all things English. She sailed with the *Wild Geese* to Flanders away and helped the French king put the enemy on the run. Then she came to America with Lafayette and checked and double checked. She finally checked in at St. Louis where a grateful citizenry erected a magnificent bronze equestrienne statue to her memory in Forest park where I have gazed at it in admiration many a time."

"All of which," I confessed "goes to show that a man never is too old to learn. All these years I have believed in my ignorance that the innocent and gentle Maid of Orleans was born in France and that her pure spirit was wafted heavenward from a cruel funeral pyre in the market place in Rouen. At one time or another I have harbored decidedly unchristian thoughts in connection with the fiends responsible for one of the most outrageous crimes in so-called civilized history. It has been a source of great pleasure to reflect that these valiant Christians believed implicitly in a future lake of eternal fire. I trust their belief has been confirmed. If I had my way—"

"If you had your way," Bill interrupted "you would drag in every character in history from Adam to Zeus and talk about them by the hour in preference to answering a simple, plain and straightforward question. You are like the Irishman's flea. Bedad, when you put your finger on him, he ain't there!"

"If this purely fictitious Irishman," I said "was only half as persistent as you, he would catch any flea that ever hopped. In a general way I had hoped you would gather the impression that I did not want to have you peeping into the little secret corner of my mind, the only one of my possessions that I really can call my own. The little corner where I do an occas-

Even Her Best Friends Would not Recognize Her

ional turn at day dreaming when I can snatch a moment from the feverish pursuit of enough filthy lucre to maintain my credit standing with the butcher, the baker and the candlestick maker."

"Snap out of it," said Bill. "Those day dreams of yours must be built on a truly magnificent scale, or on a particularly crooked scale if you are afraid or ashamed to mention them. Are you by any chance contemplating robbing a bank and then going highballing around the world with a band of roystering, screeching companions?"

"No," I said. "I am not. If I was perfectly free to do as I pleased for a couple of weeks, do you know where I should like to go?"

"Well," Bill replied, "considering the fact that I have been trying to squeeze the information out of you for the past half hour, there is one place I should like to recommend. Some people might object to the temperature, but with your early foundry training, you would feel at home. Also you would have a chance to check up on the present status of the gang who figured so prominently in a certain bonfire in the old French city of Rouen in the year of Our Lord 1431."

"Some other time," I said. "Some other time. I am in no hurry. At the moment I should like to land some fine morning, all alone, at a certain point on a small river where the clear amber water circles in an eddy before rushing off at right angles to its former course. The exposed roots of a large spruce tree overlooking this shady nook, afford a comfortable seat.

"From the dense thicket lining the bank I should select and cut a young ash or birch pole about 10 feet in length. After trimming this to my liking I should tie one end of a 5-cent line to the small end of the pole. I should fasten a hook on the other end of the line and then reeve the hook through a fat red worm in such a manner that approximately ¼-inch of the aforesaid worm remains free to wiggle. Then I would climb on the roots of the tree, prop my back against the trunk, light my pipe, drop the hook in the water and let nature take its course.

"From this vantage point I have lifted a dozen speckled trout in an hour, in days gone by, and I know of nothing that would give me greater pleasure than to do it again. One instant the rod lies inert and dead in my hands. The next instant an electric shock shoots through my entire system as the rod almost is jerked out of my hands. By main strength I drag the jumping victim ashore, struggling like a wild cat, and hit him a belt on the head to keep him quiet. There's my idea of a perfect day. Now what do you think of that, my lad?"

"Well," Bill replied judicially. "I'll tell you. The idea presents a number of alluring features. Personally, I prefer fishing off shore in salt water, but if you can make the grade and sneak off to that place you are talking about, I wish you would tip me off in time and I'll try to go with you.

"Fishing is a good deal like the foundry business. There are all kinds of fish and all kinds of ways for catching them. Similarly you can find many methods of handling almost any job that is made in a foundry.

From the Original Painting by Ole Fisher: Peace

"I had an inquiry from a man recently who wrote that he could secure an order for a cast iron smokestack 69 inches diameter, 65 feet high, ½-inch thickness of metal, to be cast in 6-foot sections. He was doubtful if this job could be made in cast iron and he would appreciate my advice on this point. If the job was practicable he should like to know the best way of making the mold.

"A casting almost 6 feet in diameter, 6 feet high, presumably with an internal flange top and bottom, and only ½-inch thick, is something out of the ordinary. The mold will require careful manipulation to insure a uniform thickness of metal and to prevent straining and cold shuts, but is quite within the range of practical accomplishment. The casting can be made in a green sand, a skin dried, a dry sand or a loam mold, or in a combination loam and sand, loam and core, or sand and core mold.

"The particular medium adopted will depend on local conditions including pattern and flask equipment, crane service, grade of sand on hand and the familiarity—or lack of familiarity—of the molders in the shop, with any of the materials mentioned. Manifestly if the men are not accustomed to dry sand or loam molding methods, or if the equipment for these methods is not on hand, it is idle to recommend them.

"Whether a new pattern has to be made, or an existing pattern adapted is a feature that well may exert a bearing on the molding method. Where a spindle is in existence and where the men are accustomed to sweeping molds, the mold may be swept in a flask or in the floor, either in sand or loam. Under other conditions a selection may be made from a comparatively wide range of molding and pattern equipment.

"Without considering every possible combination, the first and—taking everything into consideration—probably the best, cheapest and most convenient method of making the casting involves the use of a ring pattern and a corebox. A ring pattern already may be in existence of the proper outside diameter, or an existing ring pattern may be lagged to serve. Only the outside surface is needed. If no pattern is available, a drum type pattern 69 inches diameter and approximately 2 feet high can be knocked together at comparatively little expense. The corebox also can be made easily since it is simply a frame 6 inches high, 21 x 78 inches inside, resting on a bottom curved to the same radius as the inside of the casting. Two transverse ribs, one 3 inches from one end and the other 3 inches from the opposite end correspond to the internal flanges on the casting.

"A cast iron arbor for each of the 10 cores will serve more satisfactorily than a miscellaneous assortment of rods. These arbors may be salvaged each time after they have been used and thus will serve until the order is completed. In the event that the job is in a hurry, two sets of arbors will be required to keep a set of cores ahead of the molder. The estimated weight of the casting is 2100 pounds and two molders and a coremaker should cast one per day.

"The drum pattern—or any ring of proper outside diameter—is placed on a level bed in the bottom of a pit in the floor, or in a flask if a flask is preferred and is available. The method is optional and depends on local custom. The only important feature is to see that the bed is absolutely level. The shallow pattern must be drawn upward in several successive stages and must be leveled each time to insure a straight and vertical wall on the casting. The level is placed upon the center of a parallel straightedge resting upon diametrically opposite sides of the pattern.

"Another method of insuring a straight wall is to drive the ends of four, long 1 x 1-inch sticks in the sand bed close to the pattern, either inside or outside at four diametrically opposite points. With a ring pattern they may be driven on the inside, but with a drum pattern, they must be placed on the outside. The only disadvantage of driving them on the outside is that the channels they leave in the sand must be filled with sand and

slicked over after the pattern has been removed. However, that is only a trifling detail.

"After the sticks are erected, suitable marks are placed on them 12 inches apart commencing at the sand bed. The pattern is drawn upward 12 inches each time it is moved and blocked in position, with the upper edge coinciding with the proper marks on the four sticks.

"A strong, open sand is employed to form the face of the mold. It is bonded with flour or any other core binder so that it will bake firmly when the fire is applied later. Rods or soldiers at least 12 inches in length are laid radially and about 3 inches apart on every course of sand commencing about 2 feet from the bottom. These reinforce the wall and prevent it from caving in when men walk around the top after the mold is finished and before the metal is poured into it.

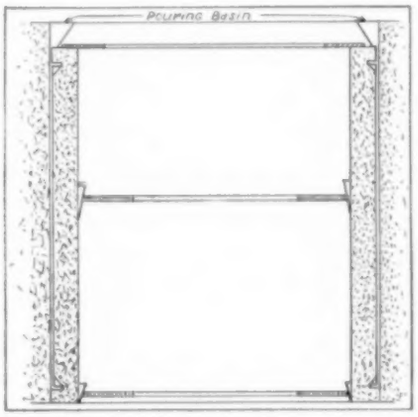
"The outside wall is rammed to a total height of 7 feet. The extra 6 inches above the top of the inside cores will serve as the outside wall of the runner basin after the mold is assembled. The inside wall of the basin may be built in green sand after a cast iron ring has been weighted down to hold the cores in place.

"The inside of the mold is formed with a set of 10 cores approximately 6 inches thick, 6 feet 6 inches in length and 21 inches wide, erected on end. The face of the mold is 7 feet high to correspond to the length of the cores and allow 6 inches above for the outside wall of the runner basis. The core extends 3 inches below and 3 inches above the casting. Each core carries the impression of the internal flanges top and bottom. It also is provided with a shoulder 3 inches wide which projects laterally ½-inch beyond the face of the top and bottom. These two shoulders touch the face of the mold and thus keep the face of the core ½-inch away from the face of the mold to form the cavity for the casting.

"After they all have been placed, the entire interior space is rammed full of sand, or, a round flask or curbing ring may be lowered into the center and the space between this flask or ring, and the cores is rammed with sand.

"The gates ¼ x 2 inches and three to a section are formed in the upper shoulder of each core by suitable little wood slabs nailed in the bottom of the corebox. The wall of the mold serves as the outer boundary of each gate. This method of gating insures an even distribution of the metal, a rapid filling and a prevention of cold shuts. Also a great number of small streams will not cut the face of the mold as the streams from a small number of large gates might.

"Four small risers are placed at diametrically opposite points to serve as indicators when the mold is full, also as flowoffs to relieve the strain. Care must be observed not to ram the sand too hard on the inside and thus bend the cores in the center with a consequent shutting off of the metal thickness in the resulting casting. It might be advisable to cast two ring plates 1-inch less in diameter than the inside diameter of the core circle. One of these rings can be placed at the bottom with a couple of wedges between each core section and the ring. The second ring can be placed about half way between the bottom



Sectional Dry Sand Cores Form the Inside of the Mold

and the top and wedged in a similar manner. With this reinforcement, the sand will be rammed hard enough by tramping it and no risk will be incurred of shutting off the ½-inch space between the face of the mold and the face of the cores.

British Foundries Study Technical Problems

(*Concluded from Page* 71)

author of the third paper, stated that air compressors are used only with maximum efficiency if they are used on full load. He emphasized the fact that compressor oil always should be as pure as possible, and kept clean. He also said that a low-pressure compressor should be as efficient as a high-pressure one; it is mainly a question of design. It is possible to descend from the full load to a lower compression, but in that case there is a risk of condensation, which must be carefully checked.

In closing this interesting discussion, during which the merits of electric steel furnaces, open-hearth furnaces and converter steel practice were discussed, A. Harley said that he favors the converter where its use is justified by the class of work, as it is a flexible process.

Various works visits were arranged during the convention; they included the works of the South Bank plant of Dorman, Long & Co., Ltd., the docks of Smith's Dock Co., Ltd., also at South Bank, and the works of Head, Wrightson & Co., Ltd., at Thornaby-on-Tees, manufacturers of electric steel castings. On the second day, visits were paid to the Port Clarence works of Dorman, Long & Co., Ltd.; Richardsons, Westgarth & Co., Ltd., manufacturers of marine engines, at Hartlepool, and the Billingham works of Imperial Chemical Industries, Ltd.

The social side of the meeting included an official reception, arranged by the Middlesbrough branch, at the Constantine Technical college, at which Mr. and Mrs. Wm. Shaw, and Dr. and Mrs. Ingall acted as hosts. The annual banquet was held on the Wednesday evening, at Stockton-on-Tees.

Book Review

Bibliographic der Electrometallurgie des Technischen Eisens (*Bibliography of the Electrometallurgy of Technical Iron*), by E. Kothny, paper, 8¼ x 11½ inches, 66 pages, published by the Verein Deutscher Giesserifachleute, Berlin, Germany and supplied by THE FOUNDRY, Cleveland, for $2.15, and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for 10s, postage extra.

During the past 30 years considerable literature has been published on the electric furnace and its application to the iron industry. However, it is difficult for those interested in the subject to maintain contract due to its wide distribution in the various technical publications of the world. For that reason the author was commissioned by the electric furnace committee of the Association of German Foundrymen to arrange a bibliography of the world's literature on the electric furnace. The subject matter is divided into 26 divisions which cover the various headings under which the reader may identify the particular phase he is interested in. Some of the divisions are: Books on the electric furnace; electrodes; equipment of the furnace; refractory linings; indirect, direct, and low frequency induction furnaces; high frequency furnaces; resistance furnaces; electrometallurgy of steel and processes; electric furnaces in the foundry; electrically heated ovens for heat treatment; etc.

Describes Furnaces

The principle of the electric furnaces of the induction type made by the Ajax Metal Co., Philadelphia, is described in a booklet recently published by the company. The application of this type furnace to nonferrous melting is covered as well as the services offered by the manufacturers. Illustrations of typical installations are given.

L. B. Knight, formerly connected with the Illinois Clay Products Co. Chicago, now is affiliated with the National Engineering Co., Chicago, as sales engineer. Mr. Knight is a graduate of Cornell university and has spent considerable time in connection with research work on sand and rebonding clays.

Fundamentals of
FOUNDRY PRACTICE

Interesting Details on the Molding of Open Sand Plates, Core Arbors and Flywheels Are Presented

By Ivan Lamoureux

(Interpreted in the Light of American Practice by Pat Dwyer)

Part XIV

UNDER certain conditions it may be advisable to form a mold without any, or with only parts of a pattern. This is a branch of the trade that calls for a high degree of skill and knowledge on the part of the molder, and a branch in which proficiency only may be developed through experience. The examples presented here are fairly typical of conditions that arise in actual practice and show methods that may be applied in whole or in part to other jobs. Molding without a pattern may be divided into five parts: open sand molding, sweep molding, molding with a templet and gage, molding with parts of patterns, mixed molding. Examples chosen to illustrate these different methods include a floor plate, a gear wheel, a pipe, a slag pot and a pump housing.

Gives Welding Variations

Some authors set up distinctions between the different methods of molding in sand, whether this is in green sand, dry sand or in skin dried green sand. These distinctions are needless. The working method is the same for all these varieties of molding. Only the treatment and preparation of the sand is different. As a rule, outside of open sand molding and sweep-molding of some gears and pulleys, molding without patterns is done in dry sand. Molding without a pattern always requires considerable patching of the mold. This operation is not without real risk.

Attention is directed to the fact, that to be able to execute a job of molding without a pattern, complete in all its details, the molder should have quite an extensive knowledge of mechanical drawing. He should be able to transfer to the sand the dimensions given on the drawing and to check the sweeps, gages and templets.

An open sand mold is formed by making an impression in the floor. Therefore it is but a drag without a cope. The lower face of the casting usually is quite clean, while the top surface is rough and covered with scurf. With proper care the top can be made quite clean.

Molding Practice

THIS installment marks the beginning of the fourth section into which the course of instruction was divided in the original plan. On account of space limitations the section will be subdivided into several short chapters for presentation in THE FOUNDRY. *The fourth section is devoted altogether to green sand molding practice and covers such typical jobs as plain plates and core irons, swept molds, sand patterns, pulleys, gear molding by many different methods, flywheels, templets and strickles, pipes, bedplates according to several methods, machine tools, centrifugal pumps and cores without patterns. Typical foundry practice in connection with the first three items is described and illustrated in this installment.*

Open molding is inexpensive hence it is used in producing pig iron, blast furnace castings, floor-plates, etc., and more particularly the core arbors or frames and plates used in the foundry.

For molding plates and simple core arbors, it is necessary in the first place to locate two perfectly straight rails or straight edges in the floor, parallel to each other and absolutely level themselves and level with each other. This is accomplished as follows:

Lay one rail level on or in the floor by resting the two ends on plates or bricks. Place another rail parallel to the first. Level the two rails by placing a spirit level on a straight edge resting on one end of the first rail, with the other end of the straight edge resting on the corresponding end of the second rail. Perform identically the same operation on the opposite ends of the rails. Adjust the horizontal height of the second rail to correspond with the first. The two rails serve as guides for laying the sand bed.

In many foundries a molding stand is reserved especially for making core spiders and the rails always remain in place. Beds prepared with wooden straight edges instead of rails, can be used only once. The straight edges usually are taken out before pouring.

It is not necessary to dwell any further upon the open sand method of molding plates. However it is much preferable to roll the bed with a roller than to press it down with a straight edge, although the straight edge is employed almost universally.

Making ordinary plates does not involve any serious difficulty, but this rule does not apply equally to molding core irons with long pins or dabbers where the pouring is not always affected without incurring accidents.

The pressure in the bottom of the opening—25 to 30 inches deep left by the pins, sometimes is severe. The sand should be rammed to resist this pressure. The fact should not be lost sight of, that a column of liquid iron 30 inches high exerts the same pressure as a column of water 210 inches high.

Molds Core Iron

Before molding a core iron with dabbers or pins, one should hollow out the floor to a depth equal to the length of the pins. Screen the sand roughly and tamp it down in successive layers of 4-inch thickness. In the majority of cases, a good treading with the feet is ample. Do not tamp the last course.

Forming of the pins or dabbers for the core iron, is characterized by the following various points: The iron or wood pin for molding the dabbers should have a diameter proportional to the height and size of the core. This diameter usually ranges between ½ and 1 inch.

The pointed end of the pin should be quite sharp, as at the left in Fig. 170, so that the pin will make a hole with perfectly smooth walls. If the rod were perfectly cylindrical as shown at the right in Fig. 170, the walls of the hole would be rough and the dabbers would be poor, which would make the ramming of the core difficult.

The pointed pin turns aside the lumps of coke and other foreign material found in the sand. The cylin-

drical pin pushes them ahead of it forming a series of cavities which the iron fills.

To prevent the destruction of one impression by inserting another pin close to it, one then uses several pins and proceeds as follows: Pins are inserted in succession at the points 1, 2, 3, 4, 5 and 6 as shown in Fig. 171. Pins 1, 3 and 5 are now pulled out, and are pushed in at 7, 8 and 9. Pins 2, 4 and 6 then are pulled out, and so on in the same manner to the end of the arbor. As an extra precaution, the mold is vented at *t*, before pulling out pins 1, 3 and 5.

When the core iron mold is finished it is sprinkled with fine dry sand. This absorbs a large amount of moisture, and reduces considerably the danger of the explosions which sometimes occur on pouring dabbered core irons.

All circular castings lend themselves readily to sweep molding; flywheels, gears, cylinder heads, cylinder, plates, etc. With inexpensive material and a drawing of the object to be cast, a variety of castings can be made economically which prove too expensive if patterns had to be made up for them. However, as a general rule, this method of molding is not justified except for large castings or where but one or two such castings are required. The teeth of coarse gears are developed with much greater accuracy by sweep molding, than with pattern molding, due to the draft which has to be allowed and the jarring in molding with a pattern.

Molds Flywheel Casting

A flywheel is to be molded having an outside diameter of 32 inches and a thickness of 5 inches as shown in Fig. 172. The hardwood sweep board (beech, maple, elm, ash) from½ to ¾-inch thick, is composed of two parts. One part conforms to the contour *a b c d e f*. It is intended to make the pattern in the sand which serves as a base on which to form the cope. The other part gives the contour *f g h i j k l*. It is intended to form the drag impression after removing the cope. The sweep should be beveled on the edge cutting the sand. This bevel may appear with a sharp angle of 60 degrees as at the left in Fig. 173 or with an angle of 45 degrees as at the right in Fig. 173. A slight thickening of the edge prevents it from wearing away too quickly. The second method is particularly suitable for diameters less than 40 inches where the outer and cylindrical contours, as at *f g*, tend to make the sand stick to the sweep.

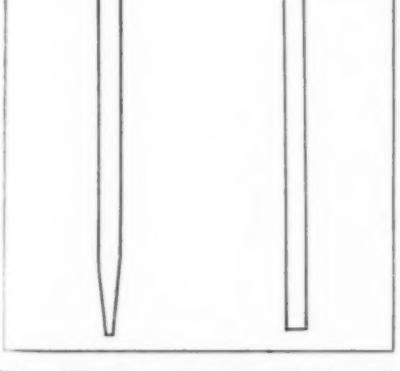


Fig. 170—*The Pointed Dabber Is Preferable to Square Ended Piece*

Attach the Sweep Arm

The sweep board is attached to the arm *T*, Fig. 174, by bolts. The arm is free to turn about the spindle *A*. A collar *B* permits adjusting the sweep-arm on the spindle. To set the sweep-arm on the spindle in a manner that will prevent any movement up or down a second collar may be adjusted above as shown in *C* Fig. 174.

The usual custom is to tighten the set collar with a bolt which passes through the side and engages the spindle with the point. The only objection to this method is that through continual adjustments the face of the spindle becomes pock marked. Also, through time, the thread on the bolt and in the bolt hole becomes worn and difficulty is experienced both in tightening the bolt and in holding it tight.

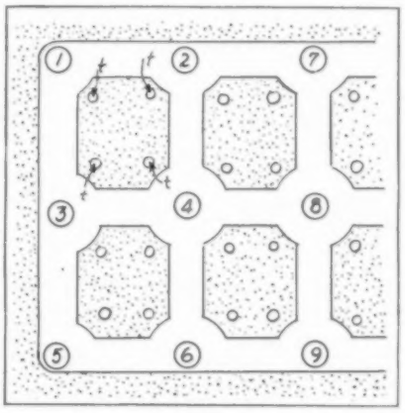


Fig. 171—*Numbers Indicate Order for Inserting Dabbers* 1 *Goes to* 7, 3 *to* 8 *and* 5 *to* 9

A better method one that is employed in many American foundries is shown in Fig. 175. In this method no collar is required. The sweep arm is set at any desired point on the spindle and then tightened by driving a steel wedge through a slot in the collar part of the arm back of the spindle. This style of arm cannot be used with a fixed spindle, but practically every spindle is free to either revolve or remain stationary.

In some instances, particularly on light work, a sweep arm may be fastened to a spindle with a bolt, thus dispensing with the collars mentioned in the first instance, and shown in Fig. 174. This arrangement also presupposes a revolving spindle.

To set up the sweep equipment for the wheel shown in Fig. 172, take a spindle 1½ inches in diameter and 5 feet long. Set up the spindle in the floor to a depth of 24 inches and plumb it well by the tamper and wooden wedges. When the mold is made in the floor, the spindle should be sunk a little lower.

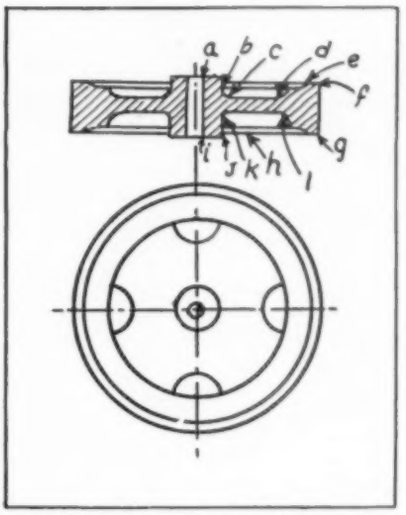


Fig. 172—*Plan and Section of Flywheel Casting*

Adjust Flask Level

When several molds are to be swept a cast iron plate or cross with a tapered bearing in the center is bedded in the floor or bolted to a bottom plate. The flask is adjusted perfectly level and in such a manner that the spindle is in the center.

For the 32-inch wheel under discussion a flask will be required 40 inches square or 40 inches in diameter and 8 inches deep if used without a bottom plate. The sweep arm is adjusted on the spindle and checked with a square for horizontal accuracy as shown in Fig. 176.

This method presumes a perfectly tight fitting arm on the spindle and one that still revolves around a fixed spindle. However, usually a small amount of play is present and for that reason it is advisable to lower the arm to the position in which it is to be used and then apply the square on the upper edge of the sweep. To insure accuracy the upper and lower edges are made parallel.

This precaution is still more necessary where the sweep arm is held on the spindle by a set screw. Tightening this bolt has a tendency to either raise or depress the arm and for that reason the sweep should not be leveled permanently until after the set screw has been tightened against the spindle. The sweep board is attached to the arm by bolts passing through suitable slotted openings which permit a certain amount of play. The outside radius is checked for accuracy and should measure 16⅜ inches to allow ¼-inch for machining plus ⅛-inch for shrinkage. One half the diameter of the spindle, ¾-inch, is subtracted and that leaves a radius of 15⅝ inches

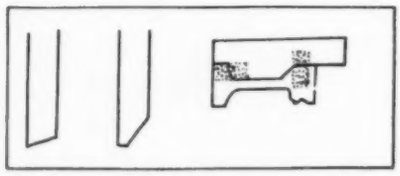


Fig. 173—(Left)—Beveled Ends on Sweeps. (Right)—Drag Sweep Attached to Sweep for the Cope

from the face of the spindle to the end of the working part of the sweep. Ordinarily, the patternmaker leaves a slight clearance between the sweep and the spindle to prevent them from rubbing. Usually the patternmaker attaches the sweep to the sweep-arm and checks it with a rule or with a spindle kept in the shop for that purpose. However, a checking over by the molder or by the foreman is an excellent precaution.

To form the sand pattern in the drag on which the cope is to be rammed the molder fills the flask with riddled sand, then rams it down with the butt rammer. The sweep is lowered to the level of the joint by digging a channel in the sand for that purpose.

Avoid Great Strains

Sufficient sand is removed to leave a rough approximation of the shape of the upper side of the wheel so that the sweep will not be subjected to too great a strain, which might throw the spindle out of plumb and needlessly wear the cutting edge of the sweep.

The sweep is moved around to the right by pressing down firmly with one hand, to overcome the resistance of the sand. The sweep may be designed to cut either right or left hand, but since the majority of men are right handed, the sweep usually is right hand.

The back and forth movement of the sweep is repeated several times and the depressions in the surface of the mold are filled with sand from the left hand. The sand should not be pounded with the hand, but pressed down firmly to make the sand stick together.

When the mold is thus roughly swept out, the sand that has accumulated in the bottom of the mold is removed. The face then is covered lightly with sieved sand and the sweep is operated with the right hand to smooth up the uneven spots left by the first sweeping. The sweep and spindle then are removed and the sand surface is covered with wet parting sand slicked on with the trowel. The flat surface is covered with dry parting sand. A pointed rod of any kind, a nail, or the point of a trowel held against the sweep to serve as a guide is employed to trace a circle representing the outside of the fly-wheel. This mark on the joint permits a judicious location of the risers.

In preparation for the cope, a layer of facing sand ½-inch thick is spread over the face of the drag. The cope then is placed on the drag. In the event that the spindle is left in place it is inclosed in a piece of pipe with an inside diameter of 2 or 3 inches. This pipe is removed before the cope is lifted and leaves a clearance for the spindle. The gate pin 1-inch in diameter is placed on the hub of the wheel. The gaggers are arranged to lift the hanging body of sand and an additional layer of facing sand is placed over the gaggers. This is followed by a 2-inch layer of floor sand and is rammed with a hand rammer. The remainder of the cope is filled with sand rammed in the usual manner. The cope then is lifted off and the spindle hole plugged with sand.

Layout Aids Nonferrous Casting Production

(*Concluded from Page* 51)

sand clinging to the surface. The casting and core are taken to a bench about 3 feet wide and 5 feet long. The top of the bench is a grating formed by iron bars spaced about an inch apart. A drawer about 4 inches deep containing a bottom of ¾-inch mesh wire is just below the grating.

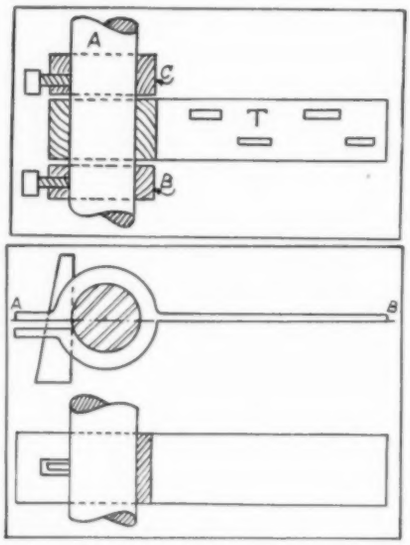


Fig. 174—(Top)—Sweep Arm Supported Between Two Collars. Fig. 175—(Bottom)—Sweep Arm Attached to the Spindle by a Wedge Key

Rapping the casting which rests on the grating causes the core to disintegrate and fall through the bars. The fine sand passes through the screen without hindrance, but any lumps of sand, wires, nails, tramp metal, etc., are retained upon the screen. A wheelbarrow beneath the screen catches the sand which is returned to the core department.

The cleaned aluminum castings then are forwarded to the grinding room where the sprues are removed and the castings are ground. The brass and bronze castings are handled somewhat differently than the aluminum castings. The former are removed from the sand and the cores knocked out without separating the castings from the gates and sprues. The gate of castings then is taken to the sandblast room and cleaned with a sandblast device supplied by the Direct Separator Co., Syracuse, N. Y. Dust from the operation is removed by a dust arrester supplied by the Pangborn Corp., Hagerstown, Md. The American company has found that cleaning the castings on the gate eliminates additional handling and also provides clean return scrap for the melting pots.

After sandblasting the castings are sent to the grinding department where the gates, etc., are removed on a sprue cutter or a band saw. The castings then are thrown into wooden tote boxes beside the machines. The tote boxes are mounted on small platform trucks equipped with small casters which raise the boxes about 18 inches above the floor. This height is such that the men have to do little stooping, and it also is the same height as the shipping platform. Consequently, the trucks may be pushed to the shipping platform and the boxes pushed off.

The boxes are at the right height for the men at the five stand type grinders supplied by the Hill-Curtis Co., Kalamazoo, Mich. The gates and risers removed from the castings are thrown into steel barrels equipped with trunnions. The barrels are handled with a special two-wheeled truck which is equipped with two yokes which fit under the trunnions.

Changes Organization

The industrial heating and welding section of the industrial department, General Electric Co., Schenectady, N. Y., have been divided into two sections. C. L. Ipsen is manager of sales of the industrial heating section, and L. D. Meeker is manager of sales of the electric welding section.

The executive offices of the Air Reduction Co. Inc., have been moved from 342 Madison avenue to the Lincoln building Forty-second street opposite Grand Central terminal, New York.

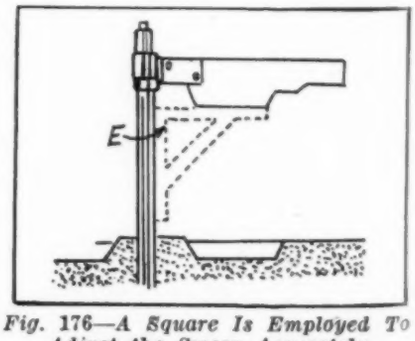


Fig. 176—A Square Is Employed To Adjust the Sweep Accurately

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Examines Molding Sand

Ueber die Pruefung des Formsandes auf seine Strukturelements (Examination of Molding Sand for its Structural Elements), by H. Nipper and E. Piwowarsky, *Die Giesserei*, Duesseldorf, Germany, May 23, 1930.

The authors state that molding sands may be differentiated from each other through nine factors as follows: Mineralogical composition of the grains; grain size; grain shape; surface condition of the grains; mineralogical composition of the clay; amount of clay; distribution of the separate minerals on the individual grain materials; distribution of the clay content and the moisture. They then proceed to take each of the headings mentioned and subdivide it into minor divisions relating to the main heading. The minor divisions show the scheme of analysis and the application of the information derived for the examination of molding sand. The article closes with data resulting from the scheme of examination on a particular type of molding sand.

Discusses Iron-Silicon Alloys

The Constitution of the Alloys of Iron with Silicon, by John L. Haughton, and Maurice L. Becker, *Iron & Steel Industry*, London, May, 1930.

This is an abstract of a paper read at the annual meeting of the Iron and Steel institute, May 1930, and is the ninth of a series of papers on the alloys of iron. The results of the research on that subject, in progress at the National Physical Laboratory and carried out under the auspices of the Alloys of Iron Research committee and under the direction of Dr. W. Rosenhain, are explained.

The article describes the methods and materials used in the determination of the equilibrium diagram for the alloys and gives the analysis of the combinations on which work was done. A short outline of the methods of thermal analysis, magnetic and dilatometric tests, heat treatment and microanalysis also are given. The remainder of the article is an explanation of the equilibrium diagram including the solidification area and transformation in the solid phases. The abstract shows the diagram as indicated by the various tests and micrographs of alloys. The article is extremely technical but should be of interest to research men.

Data on Casting Copper

The Fundamentals of Brass Foundry Practice, by R. R. Clark, *The Metal Industry*, London, June 13, 1930.

In the production of copper castings, generous feeding at all high and heavy or variable section points is required because of the high shrinkage tendency of the metal. The melting of copper has a marked effect on the condition of the castings relative to defects. Lake or electrolytic copper is preferable in the charges but if scrap metal is used care should be taken that the metal is as free from contamination as possible.

Various methods are employed to overcome gasification and oxidation. Where the required electrical conductivity is not high, 2 per cent of zinc and a trace of phosphorous may be added to correct those conditions. The addition of silicon in the form of silicon-copper, is recommended where the opposite conditions are paramount. Magnesium also is used as a degasifying and deoxidizing agent but the author does not favor it because of the tendency to make the metal drossy and slushy. Neutral agents such as sub-oxide, etc., are recommended in certain instances.

Charcoal is a reliable aid in manipulating copper. The author favors the following practice. Charge the copper and add a good shovelful of charcoal per 100 pounds of metal. If all copper can not be charged at once, the remainder is charged as soon as possible. After all copper is melted, it is brought to a high temperature, drawn from the furnace, skimmed clean, a layer of charcoal thrown over it and hurried to molds to be poured.

The remainder of the article deals with the risering of castings. Gating also is discussed. Risers often are pumped or covered with a layer of charcoal to prevent shrinkage. The author favors two kinds of gates, namely, broad thin gates that run only to the casting and skim gates to the delivery gate and the riser.

Reduces Molding Costs

Vorteilhafte Formung eines Einlaufkastens fuer ein Mischwerk unter Beruecksichtigung der Vorrichtungskosten (Advantageous Molding of a Runner Box for a Mixing Machine with Consideration of the Rigging Cost), by A. Raab, *Die Giesserei*, Duesseldorf, Germany, May 9, 1930.

The author describes the molding of a casting in the form of a four-sided shell with a hollow tubular projection extending from the top and one side. The overall dimensions of the casting were 55 inches long, 31 inches wide and 10 inches high. The first method tried was placing the parting line across the center of the 31-inch width or in other words molding it on the side. One half of the pattern was bedded in the floor with the other half in a flask made by fastening two 16 x 30 x 79-inch flasks together to give the necessary height. Since the flask was too long a partition at one end cut down the amount of sand used.

In the second method the parting line was made across the top of the casting. The whole of the pattern was imbedded in the floor and covered with a flat cope which was built up at the end where the tubular portion projected above the casting. This method proved the easiest and was saving in time effort and rigging.

Compares Malleable Irons

Malleable Cast Iron, by G. R. Shotton and H. G. Hall, *Foundry Trade Journal*, London, May 29, 1930.

While black-heart malleable is preferred in the United States where malleable iron castings are used, European countries have a similar preference to the white-heart variety. That preference is due rather to necessity because of the variety of pig iron available in Europe as compared to that in America. In this paper which was presented at the annual meeting of the Birmingham junior section of the Institute of British Foundrymen, the authors have explained the differences in practice in the production of the two types of malleable iron and the reasons for the variations.

The article deals with the discovery of the white-heart process by Reaumur in 1722 and the growth of the industry. The black-heart process was discovered accidentally by Seth Boyden. An explanation of the difference between the two types of iron is that although both varieties are brittle when cast, white-heart obtains its malleability from oxidation of carbon and the production of a type steel while the black-heart type is produced by graphitization of the carbon into small nodules and the production of a wrought-iron type structure.

Several illustrations of fractures and micrographs are shown and explained. The authors then pass to the mechanism of the solidification of white heart, explaining it by the use of the iron-carbon diagram. Ranges of analysis of the two types are: White-heart, total carbon, 3.20 to 3.80 per cent; silicon, 0.45 to 0.75 per cent; manganese, 0.30 to 0.40 per cent; sulphur, 0.20 to 0.35 per cent and phosphorus, below 0.10 per cent, while that of black-heart is: Total carbon, 2.30 to 2.60 per cent; silicon, 0.75 to 0.90 per cent; manganese, 0.25 to 0.35 per cent; sulphur, 0.03 to 0.06 per cent and phosphorus, below 0.20 per cent. They further state that according to some authorities, good quality white-heart castings cannot be made with low sulphur iron. However, since little iron of that type is available in Europe, it is one of the chief reasons for white-heart in that country.

The effect of the various elements next is discussed and following that cupola and open-hearth melting operations are described. The authors deal with the characteristics of a foundry producing malleable iron castings and discuss such subjects as sand, pattern equipment, etc. The remainder of the article is devoted to a discussion of annealing practice and to explanations of the picture frame structure sometimes found in malleable iron casting.

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The Shakeout

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¶ It Might Be Worse

NOBODY loves that cheerful idiot, the perpetual optimist. Similarly, the chronic pessimist always walks alone. Apparently the latter individual is a shade more popular than the former under present stress of business conditions. At any rate, conversation in offices, convention halls and that great American forum, the pullman smoker, seems to point that business is bad. The repeated reiteration does no service.

HOW bad is business? Undoubtedly operations in the foundry industry are lower than they were in the corresponding period last year. Perhaps many foundries are working on a schedule below their former average for several years previous. However, when figures are analyzed and percentages scanned the industry is immeasureably more active than it was during the 1920-21 depression. In fact, the percentage decline for the first six months of 1930 compared with a like period last year, in many foundries can be represented by a single digit. Most certainly this is no time to slacken sales effort. Inactivity and the abstinence from needed revision or improvement, should be considered.

SMITH-EMERY CO., chemists and engineers, Los Angeles, in a letter dated June 26, state a sound view, splendidly. We like their spirit. They say:

> Personally—we are taking advantage of this slack period to spruce up generally around our establishment. Nobody has been discharged, nobody's salary has been cut, and the payment of bills has not been unduly delayed.
>
> We are also doing a little extra advertising, giving out all the work we can to other concerns, and making a few extra calls on our friends and clients—not to talk "hard times", but just to shake hands warmly and cheerily say "Howdy?"
>
> While we believe careful consideration should be given to major expenditures, we do not believe it is a time for penuriousness or narrowness in thought or act.
>
> We may be getting a little deeper in the hole financially, but the hole is getting smaller all the time, and if we maintain our poise the hole will soon be closed altogether, and business resumed under better conditions than for years.
>
> Large concerns and public utilities employing thousands should remember—they have the same responsibility regarding the welfare of individual employes as the little fellow—the same responsibility for keeping the wheels of commerce moving, and they have no more license for discharging a lot of people who have faithfully served through "good times" than have the small concerns.

Our compliments to Smith-Emery Co. They state a business philosophy and a sound policy worth every foundryman's consideration.

¶ Castings Vs. Beans

ONE point repeatedly was stressed at the recent meeting of the Steel Founders' Society of America, reported in another portion of this issue. It was mentioned by business experts, by men of outstanding success in the steel foundry business and by specialists in merchandising. All were agreed that the practice of selling castings by the piece instead of by the pound is the only basis upon which a jobbing foundry can afford to do business. The railroad policy of buying castings on a weight schedule was criticized by one speaker who said:

> Why should a railroad expect to buy all of their castings on weight schedules? They have different freight rates for different commodities and they should pay piece prices for different castings in the same manner.

THIS point in selling castings is not new, but it is of paramount importance under present business conditions. The unscrupulous buyer may prey upon the hunger for orders to load up jobbing foundries with contracts made upon an overall price per pound. Cases have been known where such contracts made upon a basis of a definite proportion of plain castings in relation to intricate, cored jobs, have been found later, when business picked up, to be an unhappy bargain for the jobbing foundry.

ON a flat pound rate for a varied run of castings, the consumer will pay more than he should for plain work and the foundry will not make costs on the intricate jobs. The piece price basis is more nearly fair to both buyer and seller. This fact is not new to foundrymen. Many will recall in an exchange of views between a foundryman writing under the name of A. Victim and the purchasing fraternity, represented by John C. Dinsmore, in 1925, when the subject of piece price vs. pound price was discussed. Then, as now, it was agreed that the pound basis might be suitable for coal, pig iron or beans. However, any casting is a finished job of engineering construction. As such it is entitled to consideration and pricing from the viewpoint of skill and workmanship.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

E. A. BALSLEY has resigned his position as vice president in charge of operations of the Wheeling Mold & Foundry Co., Wheeling, W. Va., effective July 1. Mr. Balsley, following his graduation from the University of Wisconsin in 1902, spent 21 years in various positions with the American Bridge Co. and at the termination of his connection with that firm was operating manager of the western distirct. Following this he was for three years

E. A. Balsley

engaged in consulting engineering practice in Chicago on plant rehabilitation work. He was works manager for the Van Dorn Iron Works in Cleveland in 1926 and 1927 and since that period has been works manager, vice president and production manager for the Wheeling Mold & Foundry Co. He has been active in various organizations connected with industry and with the engineering profession.

John A. Rendle, Toledo, O., was re-elected president Sterlite Foundry & Mfg. Co., Auburn, Ind. Richard J. Schweitzer, Chicago, is vice president and A. L. Kuhlman, Auburn, is general manager and secretary treasurer of the company.

B. C. Heacock, formerly vice president, Caterpillar Tractor Co., Peoria, Ill., has been made president, succeeding R. C. Force, president since the corporation's organization. The latter now becomes chairman of the executive committee.

Dr. O. E. Harder, in charge of metallography at the University of Minnesota, has been appointed assistant director of Battelle Memorial institute, Columbus, O. He is a specialist in physical metallurgy, heat treatment and allied subjects, and will devote a portion of his time to the work being conducted at the institute by the alloys of iron committee of the engineering foundation. The institute is directed by H. W. Gillett.

F. A. Jensen, consulting foundry engineer, has been appointed by the Amtorg Trading Co., New York, to design a new steel foundry in Russia. Mr. Jensen is at present in Newark, N. J., but will be in Russia in perhaps 8 months. The foundry work covered by Mr. Jensen has been international in scope. After serving a 5-year apprenticeship he worked as a molder in Germany and Scotland for 3 years. Later, coming to the United States with the end in view of acquiring a wide foundry experience, he was employed in various capacities in a large number of different foundries. He then became connected with the Liberty Foundry Co., Portland, Oreg., as superintendent and later was made superintendent of production with the Brown & Sharpe Mfg. Co., Providence, R. I. He then accepted a position as industrial foundry survey engineer for the Sherman Corp. Ltd., Toronto, Canada, and later opened his own business as a consulting foundry engineer in Canada.

A. Harley, for the past 20 years foundry manager, Daimler Co., Coventry, England, recently was elected senior vice-president of the Institute of British Foundrymen. Mr. Harley is a native of Falkirk, Scotland, and received his education at Falkirk high school and Glasgow Technical college, Glasgow. He was trained as a metallurgical chemist in the laboratories of the Carron Co., Carron, Stirlingshire. Later he was associated with the Alloa Coal Co., Alloa, Clackmannanshire, for about two years where he was in charge of the surface plant at the new collieries then being developed near Bannockburn. He next was connected with the Coalbrookdale Co., Shropshire, as assistant to the general manager. He held that position for 9 years. Following that period he was appointed to supervise the erection of a new foundry for the Daimler Co. He was made manager by that company and has held the position for the past 20 years. In addition to his duties as manager, Mr. Harley has been in charge of the general laboratories of the company and the heat treating department for the past 8 years. He has been a member of the Institute of British Foundrymen for 20 years and is a past branch president.

Foundry Group Holds July Outing

New England Foundryman's association held its July outing at the Wampanoag Motor club, Tauton, Mass., July 9. Association members from Tauton completed arrangements

A. Harley

for the program for the day and included features in line with the slogan of the outing: "A good time for all." A baseball game between foundrymen and manufacturers was held, and provision was made for those enjoying quoits and golf. A buffet lunch was served at the club followed by a special dinner. Specialty features made up the program of entertainment.

English Firm Celebrates 200 Years in Business

W. & T. Avery Ltd., Birmingham England, manufacturers of weighing machinery and measuring instruments, will celebrate its bi-centennial anniversary this fall and has set aside several days during July for its observance. The firm was founded in a small steel yard-maker's shop at No. 11 Digbeth, Birmingham, in 1730 and has grown steadily in the 200 years that have elapsed. The Soho Foundry was acquired by the company in 1897 and supplies the castings necessary for the firm's manufacturing facilities.

The Sander Has a Specially Designed Governor

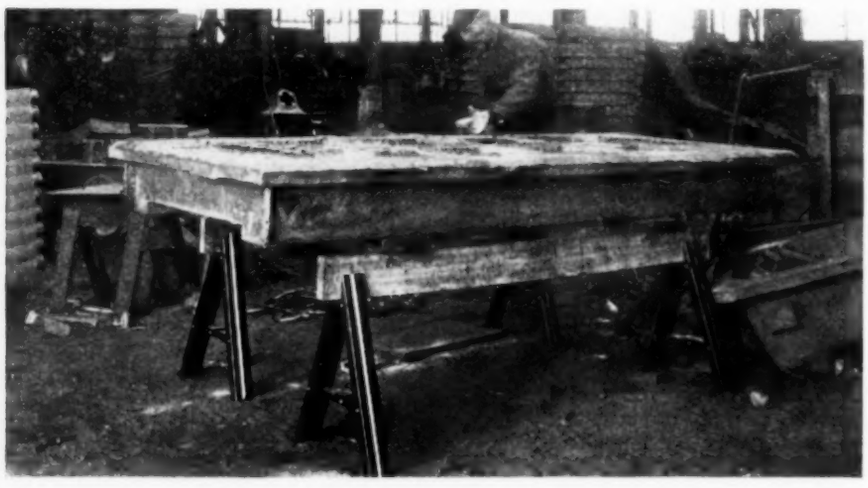
Grinder and Sander Is Air Driven

Buckeye Portable Tool Co., Dayton, O., manufacturers of portable air tools, has placed on the market a new type, pneumatic, portable, grinder and sander for use with felt pads, abrasive disks or cup wheels. The new tool is equipped with a specially designed governor which is claimed to give higher speed, use less air and give more power. The air supplied to the tool does not pass through the governor but is delivered directly to the rotor.

The sander and grinder is equipped with a safety throttle and an oil reservoir is located in the dead air handle which is tapered to a hammer handle shape to afford the operator a firmer grip. Both handles are placed near the center of the tool to give maximum grinding pressure without over-balancing.

Pressed Steel Horses Are Erected Easily

Toledo Pressed Steel Co., Toledo, O., recently has introduced a pressed steel horse which may be used for many purposes. The top of the legs are designed as jaws and the cross member is a toggle. When the cross piece is clamped the jaws grip a piece of wood which serves as a rail. The horse is disassembled easily and folds into a compact piece that makes its transportation and storage simple. Those horses may be used as temporary benches, barricades, scaffolds, etc. The accompanying illustration shows two horses supporting a large casting while it is being cleaned. The horses are manufactured in eight heights ranging from 18 to 60 inches. Different models take 1-inch or 2-inch wood rails on edge or 2 x 8 inch pieces flat.



The Horses Are Built in Eight Different Heights

One Valve Operates Molding Machine

Wm. H. Nicholls Co., Inc., Richmond Hill, Long Island, N. Y., recently has placed on the market a new jolt, squeeze type molding machine. Both the jolting and the squeezing operations of the machine are controlled by one operating valve. The machines are equipped with a jolt piston 5¼ inches in diameter and a squeeze piston 11¼ inches in diameter and 18 ½ inches long. Both the cylinders and the pistons are ground to an absolute fit to provide perfect alignment and long life. The operating valve is of the engineer's disk type.

The squeeze piston is fitted with a proprietary composition packing ring. The jolt piston has a substantial top cast integral. Air is connected to the top of the column. This eliminates complicated piping and keeps the lines off the floor. The squeeze head is made of cast steel, swings readily and can be adjusted up or down to the proper height. The face of the head is parallel to the top of the jolt table at all times and is equipped with a large bearing on the column to secure rigidity. The adjusting column has substantial lugs to stop the ram head in the correct position both when over the mold and in the out position.

The base is heavy to secure rigidity and firmness of the foundation. Jobs requiring various sized flasks within the limits of the machine, may be made without making any change in the machine. The apparatus can be equipped with a knee jolt if desirable. The base has lugs cast on for a riddle holder and mold shelf.

The unit also is available in the portable type, mounted on heavy wheels which may be slipped off easily if the device is to be converted into one of the stationary type. A machine of the portable type is shown in the accompanying illustration.

The Machine Is Made In Both the Stationary and Portable Types

A Correction

THE FOUNDRY regrets that an error was made in the caption identifying the photograph of Mr. Walcher on the "Family Photograph Album" page of the June 1 issue. The caption should read—Upper Left—E. Walcher, General Steel Castings Co., Eddystone, Pa.

American Brake Shoe & Foundry Co. of California has moved its offices from 1178 East 32nd street to 5309 East Slauson avenue, Los Angeles.

OBITUARY

Frank V. Knauss, president and founder of the Portsmouth Stove & Range Co., Portsmouth, O., died recently. He was 80 years old. Mr. Knauss founded the Washington Stamping Co., at Washington Court House, O., in 1881. Two years later he was appointed manager of the Ohio Stove Co., Portsmouth, where he served for six years. In 1889 he organized the Portsmouth Stove & Range Co., which has since become one of the most extensive foundry industries in the Ohio valley. Mr. Knauss was the company's first and only president. He also was president of the Madsenell Corp., New York, and a director of the Auto Finance Corp., Newark, N. J.

John B. Schmandt, formerly with the Schmandt Foundry Co., Detroit, died recently at his home in that city.

Sidney A. Kellar, one of the founders and for many years president of the Keller Mechanical Engineering Corp., Brooklyn, N. Y., died recently.

Benjamin F. Haughton, 80, vice president and treasurer, United States Pipe & Foundry Co., died at his home in Beverly, N. J., June 25. Mr. Haughton had been connected with the foundry company for many years.

James J. Mason, 70 years old, associated with the Buckeye Blower Co., the Utica Radiator Co., the Richmond Radiator Co., New York, and the National Radiator Corp., Johnstown, Pa., during the past 40 years, died June 29 at his home in Cleveland.

Henry Tscherning, for many years chief engineer of the Arcade Mfg. Co., Freeport, Ill., died at his home in Freeport recently. Mr. Tscherning was born in Denmark May 9, 1861. He was an inventive genius and his talents were applied to the development of a wide variety of molding machines. He has been connected with the Arcade Mfg. Co. continuously since 1896.

Edward Taggart Child, an engineer prominent in the shipbuilding and foundry industries, died recently at St. Luke's and Children's Homeopathic hospital, New York. He was 58 years old. Following his graduation from the University of Pennsylvania, he was assistant professor of Engineering there for several years. He was connected with the Southwark Foundry & Machine Co., Philadelphia, for 20 years. During the World war, Mr. Child represented the Le Parmentier Shipbuilding Co., New York. At the time of his death he was secretary-treasurer of David Baker Inc., New York, consulting engineer.

William E. Fulton, age 77 years, retired president of the Waterbury Farrell Foundry & Machine Co., Waterbury, Conn., died July 2 in Waterbury following a short illness. Mr. Fulton was born in Brooklyn and started his career with the Farrell Foundry & Machine Co., operating plants in Ansonia and Waterbury, Conn., in 1877. In July, 1880, E. C. Lewis, manager of the Waterbury plant purchased it from the Farrell family and changed the name to the Waterbury Farrell Foundry & Machine Co. Mr. Lewis became president and Mr. Fulton was elected secretary and treasurer. Upon the death of Mr. Lewis in 1901, Mr. Fulton became president of the company which position he held until 1919 when he retired after 42 years service. He took an active part in the development of Waterbury both industrially and civicly and contributed freely to the welfare of the city. Among his gifts was an extensive park known as the Lewis Fulton memorial park containing a rock garden that is one of the show places of the city.

IT has been estimated that nearly 80 per cent of the brass foundries are afflicted at one time or another with a casting condition which best may be described as sponginess or porosity. While in some cases that problem may not be of importance, it is a most serious one in castings that have to withstand pressure. Since few brass foundries exist that do not produce some pressure-type castings, it is not difficult to understand the widespread interest in ways and means to overcome porosity and in the underlying causes of the phenomenon.

Beginning with the Aug. 1 issue of The Foundry and from time to time thereafter articles will be published relating to investigations on the causes of unsoundness in bronze and brass. The articles will be written by a prominent metallurgist who prefers to remain anonymous, and will explain the theoretical and actual causes of porosity; including furnace operation, gases, etc.; the process of solidification of red metals and alloys; influence of structure; effect of other metals and impurities; effect of pouring temperature; gating of castings, etc.

Executives Appointed at Board Meeting

The annual meeting of the stockholders of the Joseph Dixon Crucible Co., Jersey City, N. J., was held recently and all directors of the company re-elected. In the organization of the new board, the directors elected G. T. Smith, president. Edward M. Cabaniss was appointed vice president in charge of manufacture, and G. F. MacOmber and J. I. McComb, assistant secretary-treasurers.

Mr. Cabaniss started his business career in 1901 with the American Tobacco Co., Danville, Va., where he was a factory clerk. He next went with the American Cigar Co., Petersburg, Va., and later was connected with the Mutual Life Insurance Co., at its Alabama general agency. In 1924 he entered the employ of the Joseph Dixon Crucible Co. as assistant to the president and vice president. After about two years he was made works manager which position he held until his recent appointment as vice president in charge of manufacture.

Officers Are Elected

Officers were re-elected at the recent meeting of the Philadelphia Foundrymen's Association Inc., Philadelphia. C. F. Hopkins, Ajax Metal Co., Philadelphia, is president; B. H. Johnson, R. D. Wood & Co., Florence, N. J., vice president; and Earl S. Sparks, Philadelphia, secretary-treasurer.

G. L. Coppage, Pusey & Jones Corp., Wilmington, Del., and Laird U. Park, Park & Williams Inc., Philadelphia, were elected to the directorate. They succeed R. R. Belleville, Joseph Dixon Crucible Co., Philadelphia, and Walter L. Kalbach, Philadelphia.

Other directors include, in addition to C. F. Hopkins and B. H. Johnson, George M. Benkert, Fairmount Foundry Inc., Philadelphia; J. A. Davies, Westinghouse Electric & Mfg. Co., Lester, Pa.; H. H. Cooke, Olney Foundry Co., Philadelphia; and C. Walter Yost, Midvale Co., Philadelphia.

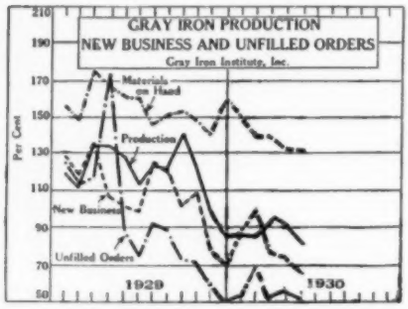
David Bartlett recently was appointed manager of the Chicago branch of the Alexander Milburn Co., Baltimore, manufacturers of oxyacetylene cutting and welding equipment, paint spray equipment, and portable carbide lights.

Trade Trends in Tabloid

A MARKED improvement has been noted during the past few weeks among malleable foundries producing general jobbing work. Malleable shops making automobile castings are slack but operations of implement plants are slightly better.

—T—T—

Compared with the alltime record established in 1929, production of automobiles in the first half of 1930 declined approximately 33 1/3 per cent. However, when compared with the output in similar periods in 1928 and 1927, which are considered normal years, 1930 production showed a slight gain. With a number of manufacturers ordering shutdowns for



part of July, not much improvement is expected for the remainder of the summer.

—T—T—

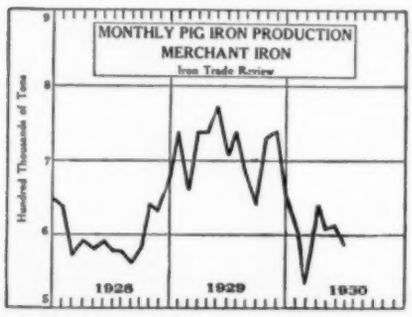
Foundry operations have been weakening further in the Chicago district. The rate, due in part to shut-downs over and after the holiday, has receded to about 50 per cent. Aluminum casting operations for several weeks have averaged 40 per cent. Brass foundries engaged in oil country and pipe line supply work are fairly busy. Steel foundries have been curtailing for the last 30 days.

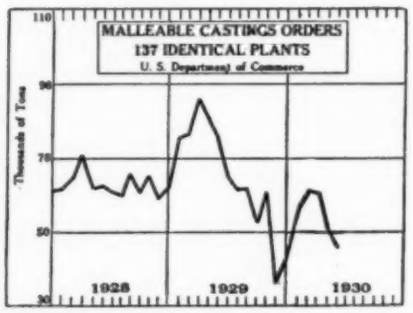
—T—T—

Production of railroad locomotives totaled 81 in June compared with 58 in May. Output for the first half of 1930 was 419 against 319 during the corresponding period in 1929.

—T—T—

Daily production of pig iron in June reached the lowest rate since January, according to *Steel*. June's





daily rate was 97,760 gross tons, compared with 104,564 tons in May and 123,887 tons for June, 1929. Total output of pig iron for the month was given as 2,932,806 tons and the production of merchant iron as 595,430 tons.

—T—T—

With an improved outlook in the machinery market in Chicago and other districts reporting a fair seasonal demand, numerous foundries making castings for that industry are increasing operations.

—T—T—

Car awards in May reached the lowest point in the year with 998 units. Orders for the first six months of 1930 totaled 32,604 units compared with 62,816 in 1929 and 28,334 in 1928. Inquiries are light and many builders have practically completed orders on hand.

—T—T—

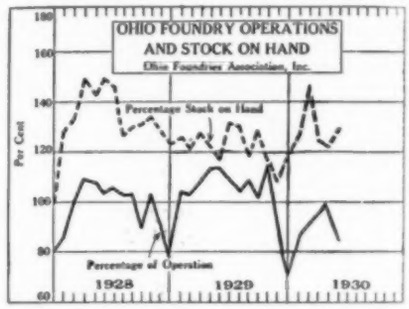
Steel founders, at the recent meeting of the society, expresed the opinion that the business recession had reached the bottom, and while marked improvement is not expected during the next few months, good business is anticipated during the last quarter of the year.

—T—T—

Foote Bros. Gear & Machine Co., Chicago, reports a heavy volume of business, due to programs in public works and road building fields. The plants of the company have been working on a 24-hour schedule, including Sundays and holidays.

—T—T—

Loadings of revenue freight during the last week of June declined 14 per cent compared with the corre-



sponding week in 1929. The decline compared with the similar period in 1928 was about 7 per cent.

—T—T—

Definite improvement in the construction industry in the last half of 1930 is indicated by the midyear survey of the Universal Atlas Cement Co., Chicago, a subsidiary of the United States Steel Corp.

—T—T—

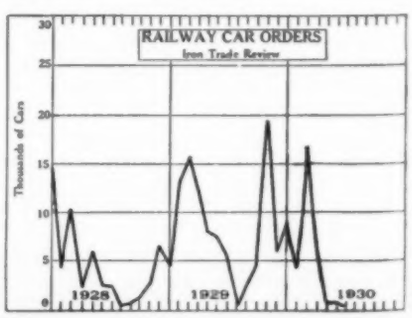
Cast iron pressure pipe shops in the Birmingham district are shipping a fair tonnage. Lettings are slow and orders on hand are being worked off gradually.

—T—T—

Average New York prices of nonferrous metals, according to *Daily Metal Trade*, were as follows in June: Casting copper, 12.056c; electrolytic copper, 12.33c; Straits tin, 30.284c; lead, 5.41c; antimony, 7.074c; aluminum, 23.740c. Zinc averaged 4.437c, East St. Louis, Ill.

RAW MATERIAL PRICES
July 8, 1930

Iron	
No. 2 foundry, Valley	$18.00 to 18.50
No. 2 Southern, Birmingh.	14.00
No. 2 foundry, Chicago	18.00
No. 2 foundry, Buffalo	18.50
Basic, valley	18.00 to 18.50
Basic, Buffalo	18.00
Malleable, Chicago	18.00
Malleable, Buffalo	19.00
Coke	
Connellsville Beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 4.50
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	14.75 to 15.25
Heavy melting steel, Pitts.	14.75 to 15.25
Heavy melting steel, Chi.	12.00 to 12.50
Stove plate, Buffalo	11.00 to 11.25
Stove plate, Chicago	9.50 to 10.00
No. 1 cast, New York	9.50 to 9.75
No. 1 cast, Chicago	12.00 to 12.50
No. 1 cast, Philadelphia	13.50
No. 1 cast, Pittsburgh	14.00 to 14.50
No. 1 cast, Birmingham	12.00 to 13.00
Car wheels, iron, Pittsburgh	15.00 to 16.00
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chi.	13.50 to 14.00
Agricultural mal., Chicago	12.25 to 12.75
Malleable, Buffalo	15.50 to 16.00
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	11.37½ to 11.87½
Electro, copper, producers	11.50 to 12.00
Straits, tin	29.87½ to 30.00
Lead, New York	5.25
Antimony, New York	7.00
Nickel, electro	35.00
Alumin'm, No. 12, producers	22.00
Aluminum, No. 12, remelt	15.50
Zinc, East St. Louis, Ill.	4.15



New Companies Added To Consolidation

North American Refractories Co., Cleveland, has purchased the assets, good will and business of the United States Refractories Corp., Mt. Union, Pa., and the Savage Mountain Fire Brick Co., Frostburg, Md. The entire organization and personnel of these concerns, headed by T. N. Kurtz, president, become a part of the North American group.

United States Refractories Corp. has been in business 18 years, and the Savage Mountain Fire Brick Co., 65 years. The North American Refractories Co. came into existence March 1, 1929, by consolidation of, Ashland Fire Brick Co., Crescent Refractories Co., Dover Fire Brick Co., Elk Fire Brick Co., Farber Fire Brick Co., and Queens Run Refractories Inc. The company owns 15 plants, located in Pennsylvania, Kentucky, Ohio and Missouri. The purchase of the United States Refractories Corp. and the Savage Mountain Fire Brick Co. increases the capacity of North American Refractories Co. from 155,000,000 to 200,000,000, 9-inch, equivalent fire brick per annum. The general offices of the company are located in the National City Bank building, Cleveland, and district sales offices are maintained in Boston, New York, Philadelphia, Buffalo, Pittsburgh, Chicago, St. Louis, and Hamilton, Canada.

Elected Vice President

J. Frank Davidson, formerly assistant general manager of the Jeffrey Mfg. Co., Columbus, O., has been elected vice president and assistant general manager. Mr. Davidson has been associated with the Jeffrey company since 1911. In addition to his service as assistant general manager, he has been employed as purchasing agent. He also is a director of the Ohio Malleable Iron Co., Columbus, O.

J. Frank Davidson

Retires as Manager

Guiseppe Faccioli, widely known electrical engineer, has retired from active participation in the affairs of the General Electric Co., Schenectady, N. Y. where he was works engineer and associate manager of the Pittsfield works of the company. His retirement is caused by ill health.

Mr. Faccioli came to this country more than 25 years ago. He was first employed by the New York Edison Co., and later by the Interborough Rapid Transit Co. He then became a designing engineer for the Crocker-Wheeler Co. In 1908 he became identified with the Pittsfield works of the General Electric Co., where his mathematical genius contributed much to the progress of electrical science. Mr. Faccioli was associated at Schenectady with the late Dr. Charles P. Steinmetz in researches in the field of lightning. The studies were continued at Pittsfield by Mr. Faccioli, and they contributed much to the success of the high voltage laboratory.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Lewisburg Stove Co., Lewisburg, Tenn., recently suffered a fire damage to its molding room.

The Carroll Foundry & Machine Co. foundry, Bucyrus, O., is being razed.

Adrian Foundry & Machine Co., Adrian, Mich., has been incorporated to engage in a foundry and machine shop business.

J. F. Devine Pattern & Mfg. Co., 535 Fifty-sixth avenue, West Allis, Wis., has awarded contract for the erection of a shop addition.

Seattle Foundries, Seattle, has been incorporated with $20,000 capital by J. J. Schwab and E. A. Flick, 913 Hoge building.

General Foundry Operating Co., 818 Atlanta avenue, Anniston, Ala., plans rebuilding that portion of the plant recently burned with a $35,000 loss.

Jones Foundry Co., 301 Pine street, Meadville, Pa., recently was damaged severely by a fire in the pattern storage and a section of the foundry.

Plant of the Acme Foundry Co., Cumming avenue and Second street, Duluth, was recently damaged by fire to the extent of $1000.

Schultz Die Castings Co., Toledo, O., has been incorporated by J. A. Schultz, care of Doehler Die Casting Co., Prospect and Smead streets, to manufacture and deal in dies, castings and machinery.

Schill Bros. Co., Crestline, O., contemplates building a 1-story foundry on Mansfield street at a reported cost of $40,000 to replace buildings recently damaged by fire. (Noted March 6.)

Acme Brass & Bronze Foundry Inc., Philadelphia, has been incorporated with $50,000 capital by Anthony H. Scherer, 6313 Bingham street, to manufacture castings and machine products.

Kilgore Mfg. Co., Westerville, O., manufacturer of toy revolvers, has awarded a contract to R. O. Karg for a 1-story, 60 x 60-foot plant addition to cost approximately $10,000.

Belding Foundry Co., Belding, Mich., manufacturer of gray iron castings and operators of machine and pattern shop, is making alterations to its plant and is adding a new unit.

Farrell Birmingham Co., Inc., 30 Main street, Ansonia, Conn., will construct a plant addition at an estimated cost of $10,000. D. Orr, 956 Chappel street, New Haven, has the plans.

Greenwood Brass and Iron Foundry, New York, has been incorporated with $50,000 capital by Nathan Bardach, 5 Beekman street, to operate a foundry.

Griffin Wheel Co., 410 North Michigan avenue, Chicago, has a building permit for fire repairs at its branch on West Evans avenue, Denver, Colo. Company manufactures car wheels.

American Steel Foundries will build a 1-story, 100 x 125-foot plant addition at an estimated cost of $25,000, at its East St. Louis, Ill. plant.

Kinney Iron Works, Twenty-Eighth street and Santa Fe avenue, Los Angeles, recently moved into its new quarters located on Forty-ninth street between Santa Fe avenue and Pacific boulevard. (Noted May 15.)

Harshaw Chemical Co., 1945 East Ninety-seventh street, Cleveland, will add to its laboratory and construct a foundry building, 86 x 100 feet on Newburg avenue. Mark Swisher, 5927 Euclid avenue, industrial engineer, has the contract.

Maryland Brass & Metal Works, Federal and Calvert streets, Baltimore, maker of brass, copper and aluminum castings, is building a 1-story, 50 x 200-foot plant at Rosedale station, Baltimore. William Gisriel Jr. is manager of the company.

National Metal Industries, Inc., Cincinnati, recently incorporated, advises that it has a plant located at 1115 Marshall avenue. The corporation was formed to manufacture and deal in machinery and appliances, including car-

rying on of the business of a foundry, pattern and machine shop. William C. Gruenberg is president.

Cooper-Bessemer Corp., Grove City, Pa., manufacturer of gas engines, B. B. Williams, president, has announced an extension of plant facilities both at the Grove City and at the Mt. Vernon, O., plants. Equipment which will be installed will cost over $250,000.

The foundry of the Lewisburg Stove Co., Lewisburg, Tenn., was damaged severely by fire recently involving a heavy loss to machinery and equipment. Plans for rebuilding have not been announced, but it is expected that work will commence soon.

Central Foundry Co., 420 Lexington avenue, New York, subsidiary of the Universal Pipe & Radiator Co., has awarded the contract for the construction of a foundry at an estimated cost of over $40,000. The plant is to be located between East 140th and 144th streets, New York.

Stockholders of the American Machine & Foundry Co., Brooklyn, N. Y., at a special meeting held June 16, approved the proposed amendment to the charter providing for an increase in the authorized capital stock from 300,000 to 1,500,000 shares without par value.

Hill Clutch Machine & Foundry Co., 6400 Breakwater avenue, Cleveland, has work under way on a foundry addition estimated to cost approximately $15,000. Clyde A. Prouty, 1463 Belle avenue, has the contract. The new unit will be used as sandblasting department.

Cleveland Co-Operative Stove Co., 2323 East Sixty-seventh street, Cleveland, K. F. Gill, president, has purchased the business and assets of the Buckeye Incubator Co., Springfield, O., and will transfer operations of the subsidiary to Cleveland, affording work for approximately 300 additional men.

Mullins-Gilson Mfg. Co., Rushville, Ind., whose plant recently was damaged by fire, has awarded a contract to G. C. Bishop for rebuilding a 1-story, 45 x 75-foot, foundry building. (Noted June 1.)

Constructing quartermaster, Capt. L. M. Doten, closed bids July 12 for a group of buildings to be constructed at Wright field, Dayton, O., which will include a foundry.

New Trade Publications

UNIT HEATER—Buffalo Forge Co., Buffalo, N. Y., describes in a current bulletin a unit heater with twin fans, with rating tables and dimension diagrams.

LOADING CHAIN—High strength with minimum weight is claimed for its loading chain in a leaflet by the American Chain Co. Inc., Bridgeport, Conn. Specifications are given.

REFRACTORY CEMENT—A leaflet published recently by E. J. Lavino & Co., Philadelphia, describes its chrome ore cement for refractory cementing and patching furnace linings.

UNIT HEATERS — American Foundry Equipment Co., Chicago, recently has issued a pamphlet describing the electric unit heaters which it makes. Data tables and illustrations of typical uses are included.

AIR FILTERS—National Air Filter Co., Louisville, Ky., has published a catalog describing line of dust arrestors that it manufactures. An explanation of the operating principle is followed by data and illustrations on typical installations.

HEATING DEVICES — General Electric Co., Schenectady, N. Y., has published a folder describing immersion heaters, glue pots, lead and cyanide pot-type hardening furnaces, and various electric resistance heating units which it produces.

STEEL BUILDINGS—Truscon Steel Co., Youngstown, O., devotes a current bulletin to its standardized steel building stock units for industrial use. Illustrations fill most of the pages, showing structures built of these units.

CONVEYORS—Bailey-Burruss Mfg. Co., Atlanta, Ga., has printed two folders describing its screw conveyors. Illustrations, data, and price list are included as well as description of power transmission devices and ball bearing housings made by the company.

BRONZE ALLOY — Bridgeport, Brass Co., Bridgeport, Conn., has issued a booklet on duronze, a silicon bronze the company has developed for uses where high strength is desired. The booklet describes the alloy and illustrations show uses.

DILATOMETERS—The R. Y. Ferner Co., Washington, recently published a catalog giving information on its industrial thermal anlyzers and differential dilatometers. These devices are used for making thermal studies of steels, alloys, refractories, silica bricks, etc.

NONFERROUS INGOTS — The American Brass Co., Waterbury, Conn., has published a bulletin describing its copper-silicon-manganese alloy ingots for high strength engineering castings. Ingot data, general properties, and suggestions for melting and pouring the alloy are given.

GRINDING WHEELS—Carborundum Co., Niagara Falls, N. Y., has issued a booklet covering the grinding of cemented tungsten carbide. General methods and equipment are described as well as the special wheels made by the company for the purpose.

CRANES — Northern Engineering Works, Detroit, has issued a catalog of its cranes in a looseleaf binder. It covers the entire line and is illustrated to show the mechanism and various features of construction. The catalog contains various bulletins bearing on the use of cranes for various purposes.

ALLOYS—Niagara Falls Smelting & Refining Co., Buffalo, has made available the second edition of a booklet, *Facts for Foundrymen*. The publication covers various applications of alloys in the foundry and describes the intermediate alloys made by the company. Useful information of a general nature also is given.

THE ELEMENTS—P. C. Kullman & Co., 110 Nassau street, New York, has compiled a list of 92 elements with atomic numbers, symbols, atomic weights, melting points and date of discovery. It is a compact listing of the basis of chemistry and industry.

GRINDING EQUIPMENT—Safety Grinding Wheel & Machine Co., Springfield, O., has issued a pamphlet describing its portable swing-frame grinding machines. Illustrations, data and specifications covering typical machines are included. Similar data are included in a second pamphlet covering floor grinders.

SCREW CONVEYOR DRIVES—Link-Belt Co., Chicago, has compiled a book describing its line of screw conveyor drives built by H. W. Caldwell & Son Co., Chicago, a subsidiary. Illustrations show the drives and typical installations. Engineering data are appended, enabling selection of the most suitable drive for a given installation.

LOCOMOTIVE CRANES — Industrial Brownhoist Corp., Cleveland, describes its gas and diesel-powered locomotive cranes of 10 to 40 tons capacity in a recent catalog. Illustrations show the cranes in action in a large number of applications. A detail diagram shows the parts and tables cover capacities and clearance dimensions.

ENGINE DESIGN — International Nickel Co., Inc., 67 Wall street, New York, has published a reprint of a paper presented by E. J. Hall, Hall-Scott Motor Car Co., Berkeley, Calif. The paper deals with the design of the Hall-Scott motor coach engine, and reference is made to the use of nickel in the materials of construction.

REFRACTORY PRODUCTS—Corundite Refractories, Inc., Massillon, O., has published a catalog containing information on the use of standardized clay fire brick and special refractories. The line of products made and the services rendered by the company are described. Useful, general engineering information is given in a series of tables included in the catalog.

AIR COMPRESSORS — Westinghouse Traction Brake Co., Pittsburgh, has issued a series of catalogs describing its air compressor equipment. Catalog T-2032 describes and illustrates 200 to 700 cubic foot displacement, compressors made by the company. Catalogs, T-2047 and T-2048 are devoted to smaller, automatic motor driven compressors. The series is well illustrated and contains engineering data and installation diagrams as well as general description of the equipment.

INDUSTRIAL CONTROL—General Electric Co., Schenectady, N. Y., has issued a catalog consisting of a reprint of the industrial control section of the general catalog, pages 825 to 985. It gives information on representative lines of industrial control made by that company, and includes instructive material on the care and operation of control devices; wiring diagrams of standard controllers, push buttons, and accessories; reference tables; list of publications and other useful information.